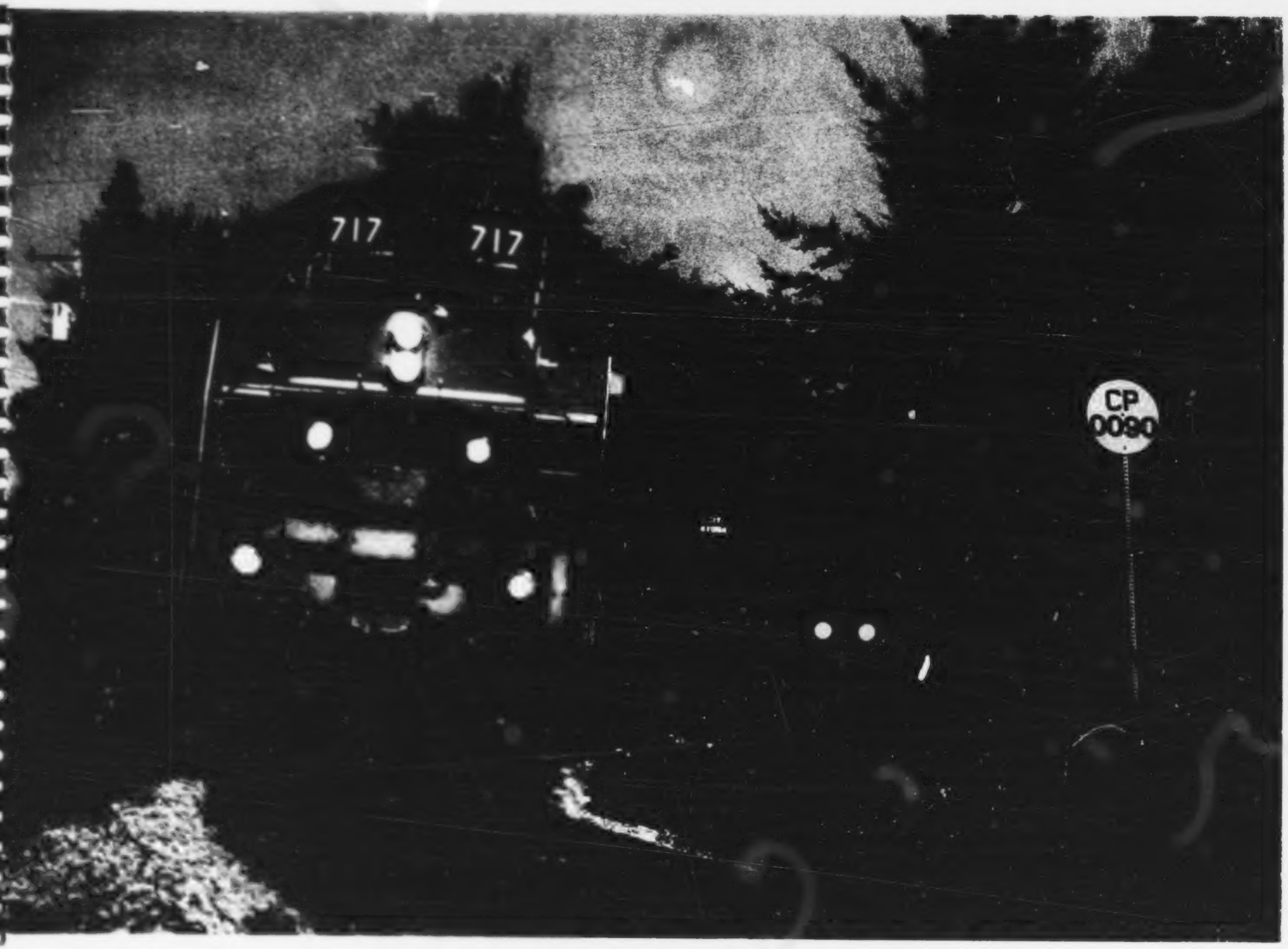
TP5914E

OPERATIONAL EVALUATION OF TRAIN CONTROL AND DISPATCHER ASSIST FUNCTIONS



LOCATION IDENTIFICATION AND CONTROL

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REPARED FOR TRANSPORTATION DEVELOPMENT CENTRE
AND B.C. MINISTRY OF INDUSTRY
AND SMALL BUSINESS DEVELOPMENT

REPARED BY B C RAIL

NOVEMBER 84

TP 5914E

OPERATIONAL EVALUATION
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AND
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PREPARED FOR:

TRANSPORTATION DEVELOPMENT CENTRE
AND B.C. MINISTRY OF INDUSTRY
AND SMALL BUSINESS DEVELOPMENT

PREPARED BY:

G.D. TAYLOR

BC RAIL

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The contents of this report reflect the views of the contractor and not necessarily the official views or policies of the Transportation Development Centre or the B.C. Ministry of Industry and Small Business Development.

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17. Abstract

This report describes and evaluates installation and testing of the train control and dispatcher assist functions of the Location, Identification and Control (LIC) system installed in the Squamish Subdivision of BC Rail. The LIC system is a computer-based block control system for railway traffic management. The initial work involved completing installation of the on-board equipment in 36 engines and 30 cabooses, and installing the necessary computer hardware and software for train control. A comprehensive set of operating rules was specially developed for the system. The second phase progressed to the point of operational parallel testing with the train order system. Testing was terminated as the system did not meet all operational requirements. Four major problems were identified: 1. Data Collection Processor (DCP) was unable to correctly analyze all valid train movements. 2. The DCP software was unable to operate for prolonged period of time before its data base became corrupted.
3. Communications with trains was too slow with only a few trains in the system.
4. Significant sections of track lacked proper communications coverage.

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17. Résumé

Ce rapport décrit et évalue les fonctions de surveillance et de régulation du système LIC (Localisation, identification et commande automatiques des trains) que B.C. Rail a installé dans sa subdivision de Squamish. Il s'agit d'un système informatisé de cantonnement et de régulation du trafic ferroviaire. Dans un premier temps, 36 locomotives et 30 wagons de queue avaient été équipés du matériel électronique nécessaire ainsi que du logiciel de commande. Un mode opératoire complet avait été élaboré à cet effet. Ensuite, ce fut l'exploitation du système parallèlement au système existant par ordres de marche. Il a été décidé de mettre fin aux essais, le système ne satisfaisant pas à toutes les exigences définies, notamment dans les quatre domaines suivants: 1. Le processeur de données ne rendait pas parfaitement compte de tous les mouvement des trains - 2. Le logiciel du processeur de données ne pouvait fonctionner longtemps sans introduire des erreurs dans la base de données - 3. La communication avec les trains était trop lente même lorsque le nombre de trains occupant le réseau était faible - 4. Une bonne liaison hertzienne était difficile à établir avec certains tronçons parmi les plus importants.

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EXECUTIVE SUMMARY

1. BACKGROUND

BC Rail have conducted the installation and operational evaluation of a train location, identification, and control (LIC) system on the railway's 154-mile Squamish Subdivision. The LIC System uses distributed processing and digital radio to monitor and control train movements from a central dispatching office. The current project was started in 1979 under a contract between the Railway and Transport Canada Research and Development Centre, now called the Transportation Development Centre (TDC). The work was based on earlier LIC prototype development carried out by BC Rail, Glenayre Electronics Ltd., and Transport Canada.

The first phase of implementation and testing was completed in January, 1983, and the work accomplished is described in detail in Report TP4451 "Operational Evaluation of Train Tracking and Dispatcher Assist Functions, Location, Identification and Control". Four specific areas were examined in that phase of the project:

- Transponder Reporting: The mean success rate for transponder reporting was 99.86%, which exceeded the minimum required by the test specification (99.8%).
- Odometer Calibration: As a result of erratic low speed performance of the locomotive axle generators, it was not possible to achieve the desired level of odometer accuracy on a consistent basis; however, the problem was not felt to affect implementation of LIC control.
- Communications Coverage: By the end of the test period an average of 71.7% of all transmissions from the central office were correctly received and responded to by mobile (engine and caboose) units addressed during transit of the subdivision. While this rate was adequate for tracking purposes, it was considered to be insufficient for train control. Detailed study showed that the problem was due to non-uniform coverage of the subdivision. Specific geographical areas of poor coverage were identified.
- Train Location: Two methods were used to provide a regularly updated display of train location. The DCP train graph, produced on a standard printing terminal, gave a reliable but low-resolution picture of train positions. A more precise indication, subject to certain limitations, was afforded by the colour graphics display.

The LIC dispatcher interface uses video display terminals, printers, and multiple colour graphics displays to provide the following: Automated train sheets, colour graphics, track diagram display, dispatcher displays and reports, and dispatcher shift change functions. Upon completion of the evaluation of the train tracking and dispatcher assist functions, it was recommended that the LIC project proceed with implementation of train control. Work was to be continued on the outstanding items as noted above.

2. OBJECTIVES

The overall objectives of this phase of the project were to:

1. Complete the installation of train subsystems on 36 engines and 36 cabooses, with provision of all necessary spares and instructional manuals.
2. Instal computer hardware and software necessary for train control and successful demonstration of its operation.
3. Develop a set of LIC Operating Rules.
4. Demonstrate full system availability and acceptance for parallel in-service testing.
5. Operate the LIC system in parallel with the manual train order system to establish system acceptability.
6. Demonstrate LIC without the support of train orders.
7. Prepare and submit to the scientific authority of TDC fifty copies of a final report describing the LIC system as installed on BC Rail.

The project was funded by the Transportation Development Centre, B.C. Ministry of Industry and Small Business Development, and BC Rail.

FINANCIAL SUMMARY

LIC PROJECT 1979 - 1984

PROJECT SPONSORS	AMOUNT
Transportation Development Centre	$1,600,000.
B.C. Ministry of Industry and Small Business Development	$ 830,000.
BC Rail	$ 770,000.
Project Cost	$3,200,000.

3. EQUIPMENT INSTALLATION ON ENGINES AND CABOOSES

The configuration of the BC Rail system permitted a total of 66 distinct ELU identifiers. BC Rail assigned 36 ELUs to engine service and 30 to caboose service. Equipment was installed on 29 freight engines, 5 passenger units (RDCs) and 1 track inspection vehicle. One set of engine equipment was reserved for bench tests.

After some initial interrogator mounting problems were solved through development of a suitable fixture, installation on RDCs and RS-30 freight units was completed without further difficulty. The longer wheelbase of the GF-30 trucks, however, forced the railway to redesign the interrogator mounting base for use on engines 751-756.

4. DEVELOPMENT OF LIC OPERATING RULES

In 1976, the BC Rail Rules Department drafted an initial set of LIC Operating Rules which subsequently were appended to the LIC System Functional Specification. With the assistance of LIC development personnel, the Rules Department updated the original draft in April, 1982. The System Supervisor of Rules then co-ordinated a series of working committee meetings with Operations supervisory personnel throughout the system in order to fine-tune the LIC rules.

The resulting version of the LIC rules, published in January 1984, is sufficiently complete to begin parallel operation. The Rules Department will use the experience gained during parallel operation to determine the need for any further changes or additions.

5. INSTALLATION AND TESTING OF THE CENTRAL CONTROL HARDWARE AND SOFTWARE

The central office LIC computer equipment required for train control comprises duplicate Host/DCP processor pairs, various peripherals, and the equipment used to interconnect these devices. Installation of the central control hardware has been completed with the exception of two items: the second DCP and the fault indicator panel. The system was operated in the single processor configuration. Development of the Host and DCP software necessary to support dual processors had been deferred under an agreement with TDC.

Installation of the LIC train control software commenced in December, 1982, and the initial software acceptance tests were completed in August, 1983. The work was divided into four stages of progressively greater software complexity and functional capability as follows:

1. Straight-through control: Basic control functions, but no checks for conflicting train movement.

2. DCP conflict: Conflict checking enabled in DCP software only.

3. Host conflict: Conflict checking enabled in Host software only.

4. Full system conflict: Conflict checking enabled in both Host and DCP software.

In early testing the system had a problem validating and analyzing all train movement and control data. A good portion of these problems were created by the train dispatcher performing functions before previously issued functions were completed. This was a result of slower system operation than anticipated, and the dispatcher's eagerness to keep up with the trains, and lack of meaningful system generated condition codes.

At the end of the test period we were only able to control trains by introducing the following:

> Imposing limitations on the use of some of the train dispatcher control functions, and reducing the amount of trains controlled at any one time on the subdivision to a maximum of five. The dispatcher was asked not to use some functions, and limit the situations where he used others. He was also asked to exercise care, and be certain previously issued transactions were completed before proceeding with others.

When the system became inoperable as a result of the inability to process and complete all protocols between subsystem components, the Host and DCP normally had to be reset to recover. When the system was in the progressive degradation process of failing as a result of a protocol's problem, its inability to convey detailed error conditions to the dispatcher caused considerable frustration.

The installing and testing of conflict and train control software can be summarized as follows:

> The system could not meet original specification requirements and acceptance requirements.

6. SYSTEM PERFORMANCE

On January 9, 1984 the LIC System commenced parallel operation and two weeks later parallel was terminated because of poor performance. The system was left in a holding pattern until an evaluation was conducted. In may, 1984 the evaluation was completed, and from the view of the dispatchers using the system during the development period, the operational capability of the system varied from fair to poor.

After the tracking functions of the system had been successfully demonstrated, progress in development became cyclic in nature. As problems in one area were identified and corrected, problems in other areas were uncovered. Although this kind of problem solving is not unusual in projects of this nature, the magnitude of the process was greater than that which even now should be reasonably expected. This was an organizational problem which, although causing schedule delays, did not directly result in termination of the project.

Four major functional problems ultimately caused the project to be terminated. These were:

1. The DCP software was unable to correctly analyze all valid train movements.
2. The DCP software was unable to operate for prolonged periods of time before its data base became corrupted.
3. Communications with trains was too slow with only a few trains in the system.
4. There were significant sections of track in which communication with trains was impossible.

7. EQUIPMENT RELIABILITY

Information collected over a 12-month period indicates that:

1. The reliability of all fixed equipment (central computers and communications) is acceptable for stand-alone operation.
2. The reliability of equipment mounted on units is too low. The problems associated with acquiring specific units for correction of known defects in addition to the cost associated with maintaining the equipment are too high. The low reliability would also compromise the LIC capability in stand-alone operation.

8. CONCLUSIONS

The continued development of LIC has been terminated under the existing project contractual arrangements. The system failed to provide adequate performance for parallel operation to be successfully completed. The major causes of the failure are associated with poor communications and software problems with the DCP.

Despite the termination, the project has demonstrated the feasibility of the LIC concept and has provided project personnel with valuable experience. Also, the system deficiences are now well identified.

9. RECOMMENDATIONS

Based upon the experience gained during the project, three basic recommendations are made. These are:

1. Further funding should be sought to remove deficiences from the system to provide stand-alone operational capability.
2. The continued development should proceed as soon as possible.
3. A number of detailed technical and organizational recommendations for the continued development are made.

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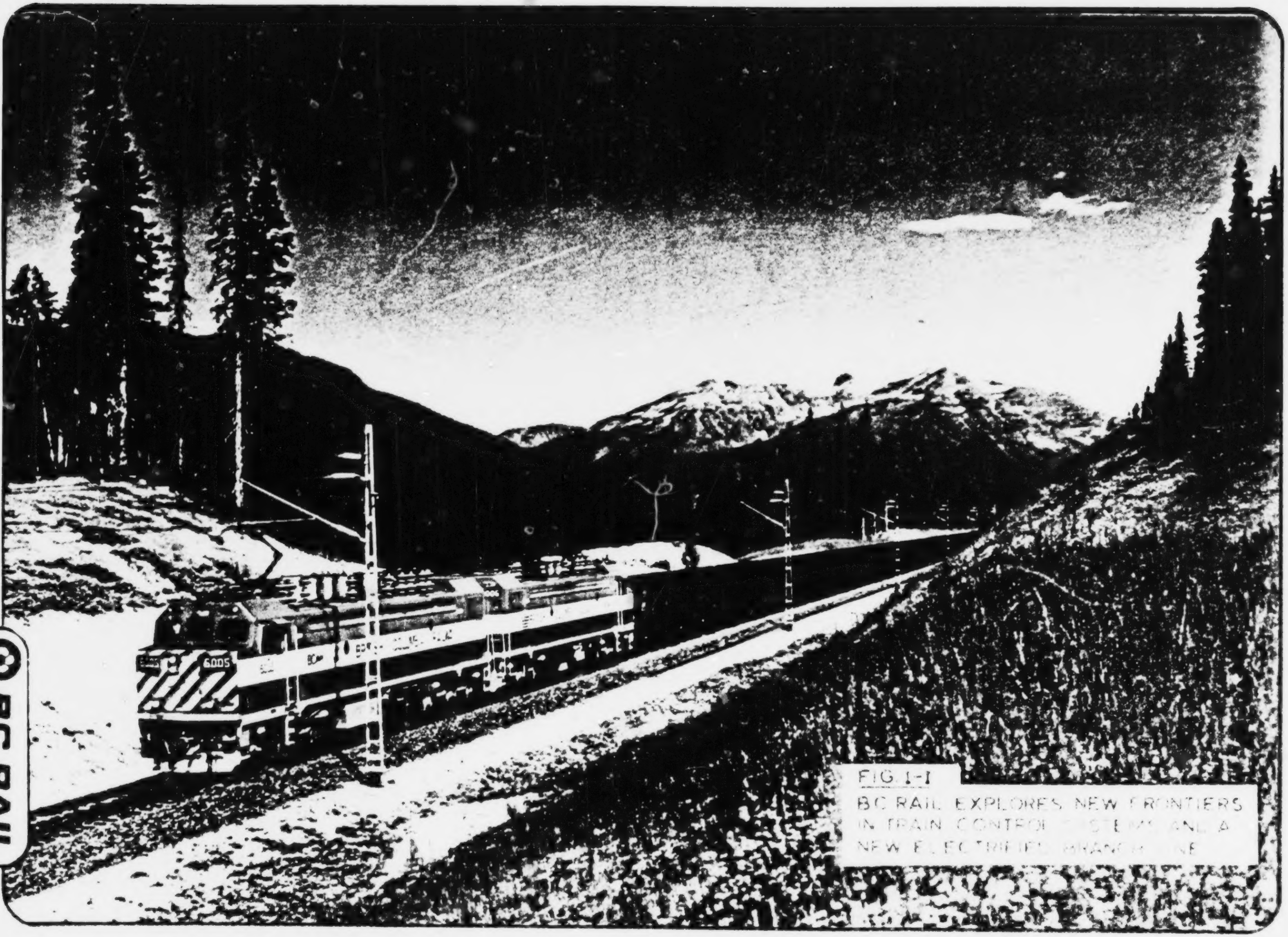
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FIG. I-1

BC RAIL EXPLORES NEW FRONTIERS IN TRAIN CONTROL SYSTEMS AND A NEW ELECTRIFIED BRANCH LINE

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OPERATIONAL EVALUATION OF TRAIN CONTROL AND DISPATCHER ASSIST FUNCTIONS

LOCATION, IDENTIFICATION, AND CONTROL

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1. INTRODUCTION

1.1 Background

BC Rail is presently conducting the installation and operational evaluation of a train Location, Identification, and Control (LIC) System on the railway's 154-mile Squamish subdivision. The LIC System uses distributed processing and digital radio to monitor and control train movements from a central dispatching office. The current project was started in 1979 under a contract between the railway and Transport Canada Research and Development Centre (TDC). The work was based on earlier LIC prototype development carried out by BC Rail and Glenayre Electronics Ltd. of North Vancouver, B.C.

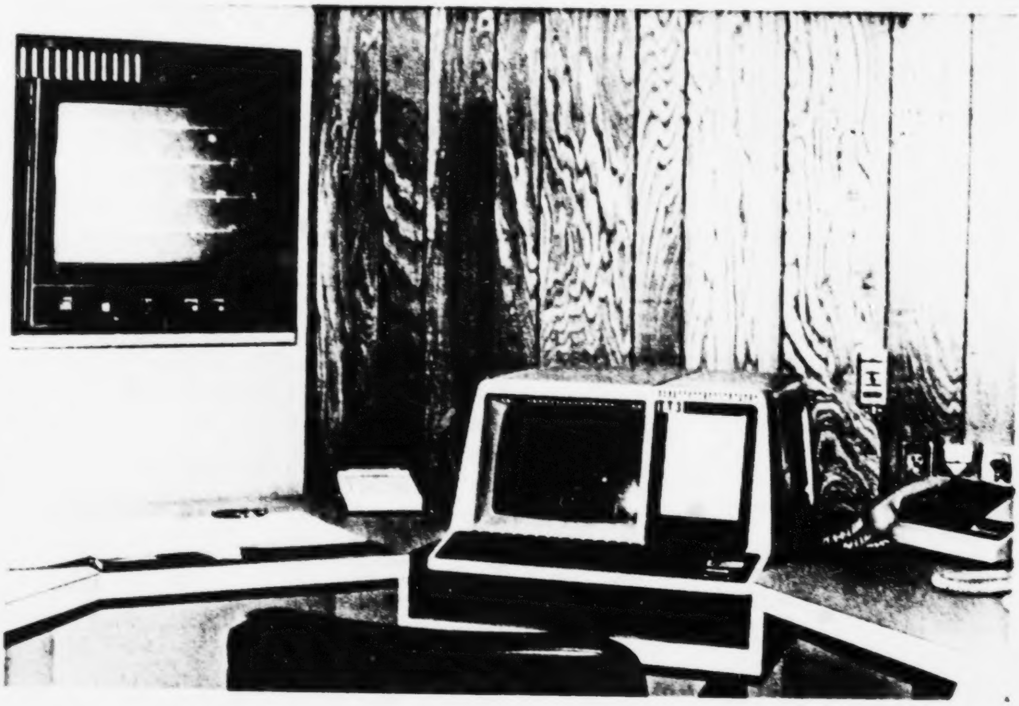

FIGURE 1-2 BC RAIL LIC PROTOTYPE SYSTEM 1976-1978

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The tasks outlined in the contract work statement can be grouped into three main phases:

- planning, initial equipment installation and evaluation of LIC train tracking and dispatcher interface functions.
- completion of equipment installation, and evaluation of LIC train control functions.
- demonstration of satisfactory LIC operation in parallel with the existing train order control system and, finally, on a stand-alone basis.

Work on the first phase of implementation and testing was completed in January, 1983 (1). Four specific areas were examined in Full Tracking tests, with the results described below:

- Transponder Reporting: The mean success rate for transponder reporting was 99.86%, which exceeded the minimum required by the test specification (99.8%).
- Odometer Calibration: As a result of erratic low speed performance of the locomotive axle generators, it was not possible to achieve the desired level of odometer accuracy on a consistent basis; however, the problem was not felt to affect implementation of LIC control.
- Communications Coverage: By the end of the test period an average of 71.7% of all transmissions from the central office were correctly received and responded to by mobile (engine and caboose) units addressed during transit of the subdivision. While this rate was adequate for tracking purposes, it was considered to be insufficient for train control. Detailed study showed that the problem was due to non-uniform coverage of the subdivision. Specific geographical areas of poor coverage were identified.
- Train Location: Two methods were used to provide a regularly updated display of train location. The DCP train graph, produced on a standard printing terminal, gave a reliable but low-resolution picture of train positions. A more precise indication, subject to certain limitations, was afforded by the colour graphics display referred to in the next paragraph.

The LIC Dispatcher interface uses video display terminals, printers, and multiple colour graphics displays to provide the following functions:

- Automated Train Sheet: The LIC central computer maintains an automated train sheet for every train known to the system. Train sheet information is entered both manually by the dispatcher (e.g., supply data) and automatically by the computer (e.g., train location). This function met specification except in the association and disassociation of active units with dispatcher created train sheets. Implementation of Control was expected to eliminate this problem.

- Colour Graphics Displays: Three colour graphics displays mounted above the dispatcher's desk show a scale representation of LIC territory and all train activity therein. The resolution and accuracy of the display system were found to meet the design criteria; however, the original specification could not guarantee exact train location at all control points. It was decided to base train location at control points on transponder crossing reports rather than odometer readings when the system operates in control mode.

- Dispatcher Displays and Reports: LIC provides the train dispatcher with a wide range of data displays and printed reports, all of which were found to meet specification as far as could be determined in tracking-only mode. Section 4.4 of Reference (1) discusses these displays and reports.

- Dispatcher Shift Change: The system specification outlines a detailed procedure for dispatcher shift change. As the system was still under test, only those parts of the procedure required to gain access to the terminals have been used.

Upon completion of the evaluation of the train tracking and dispatcher assist functions, it was recommended that the LIC project proceed with implementation of Train Control. Work was to be continued on the outstanding items noted above.

1.2 Objectives and Scope

The purpose of this document is to summarize the work done to implement and test the Train Control functions of the LIC System and to evaluate the performance of the complete System. The work was performed by BC Rail in conjunction with Glenayre Electronics Ltd. and Datap Systems.

This report covers Tasks 5 through 10 of the contract work statement as outlined below:

TASK 5: Completion of installation of train subsystems on 36 engines and 30 cabooses, with provision of all necessary spares and instructional manuals.

TASK 6: Installation of computer hardware and software necessary for train control and successful demonstration of its operation; development of a set of LIC Operating Rules.

TASK 7: Demonstration of full system availability and acceptance for parallel in-service testing.

TASK 8: Operate the LIC system in parallel with the manual train order system to establish system acceptability.

TASK 9: Demonstrate LIC without the support of train orders.

TASK 10: Prepare and submit to the scientific authority fifty copies of a final report describing in detail the LIC system as installed on BC Rail.

This report represents the final step in completion of Task 10.

1.3 Outline of Report

Section 2 provides an overview of the complete system by describing train control, train control functions, Host/DCP communications, and the cab display unit which the engineman uses to view his operating authority. Section 3 specifies equipment installation in terms of the train sub-system and central computer sub-system. A previous report described communications and trackside equipment installations (TP 4451). Section 4 explains the development of a special set of operating rules for LIC. Section 5 documents the results of installation and testing of the train control software. Section 6 provides an evaluation of the complete system and Section 7 expresses system reliability. Sections 8 and 9 deal with conclusions and recommendations.

2. SYSTEM DESCRIPTION

The purpose of this section is to describe the train Location, Identification, and Control (LIC) System as it is implemented on the Squamish subdivision of BC Rail. Section 2.1 gives an overview of the LIC System. Section 2.2 is a functional description of the central office portion of LIC Train Control, and Section 2.3 discusses communications between the DCP and Host computer systems. Section 2.4 describes the locomotive cab display used to present operating instructions to the engineman.

2.1 Overview

The LIC System is a distributed-intelligence system designed to track and control train movements from a central dispatch office. The central computer communicates by radio with engines and caboose to obtain complete operating data for each train. This information, continuously updated, is used to generate a graphic display of all activity in the controlled territory. Train movement instructions entered by the dispatcher are verified and then transmitted to the appropriate locomotive where they appear on a plain-language cab display.

LIC comprises three major subsystems: The Central Computer Subsystem (CCS); the Train Subsystem (TSS); and the Communications Subsystem (CSS). The following paragraphs briefly describe the LIC subsystems; for greater detail refer to Appendix A of this document.

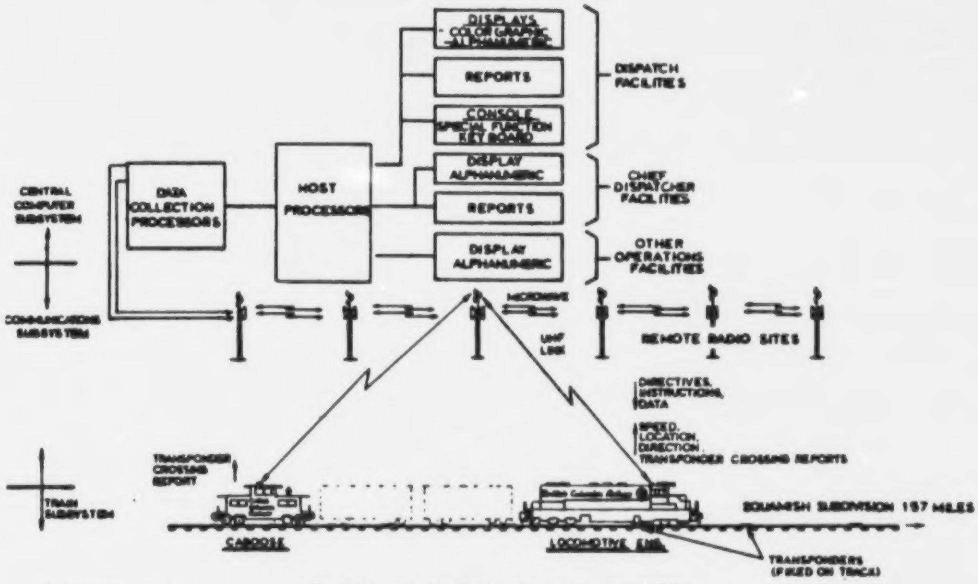

DISPLAYS
COLOR GRAPHIC
ALPHANUMERIC
REPORTS
CONSOLE
SPECIAL FUNCTION
KEY BOARD
DISPATCH FACILITIES
DISPLAY ALPHANUMERIC
REPORTS
CHIEF DISPATCHER FACILITIES
DISPLAY ALPHANUMERIC
OTHER OPERATIONS FACILITIES
CENTRAL COMPUTER SUBSYSTEM
DATA COLLECTION PROCESSORS
HOST PROCESSORS
COMMUNICATIONS SUBSYSTEM
MICROWAVE
UHF LINK
REMOTE RADIO SITES
DIRECTIVES, INSTRUCTIONS, DATA
SPEED, LOCATION, DIRECTION, TRANSPONDER CROSSING REPORTS
TRANSPONDER CROSSING REPORT
TRAIN SUBSYSTEM
CABOOSE
LOCOMOTIVE ENG.
SQUAMISH SUBDIVISION 157 MILES
TRANSPONDERS (FIXED ON TRACK)

FIGURE 2-1 BLOCK DIAGRAM OF LIC SYSTEM

The Central Computer Subsystem, located at the dispatch office, comprises a Host minicomputer, a front end Data Collection Processor (DCP), and various peripherals. The DCP controls the communications channel, polling each train in turn to collect location and status data. The Host supplies the main dispatcher interface which includes video terminals for command and data entry, report printers, and a colour graphics train tracking display. The Host and DCP communicate over a high-speed serial link, and each performs checks on data received from the other prior to processing it.

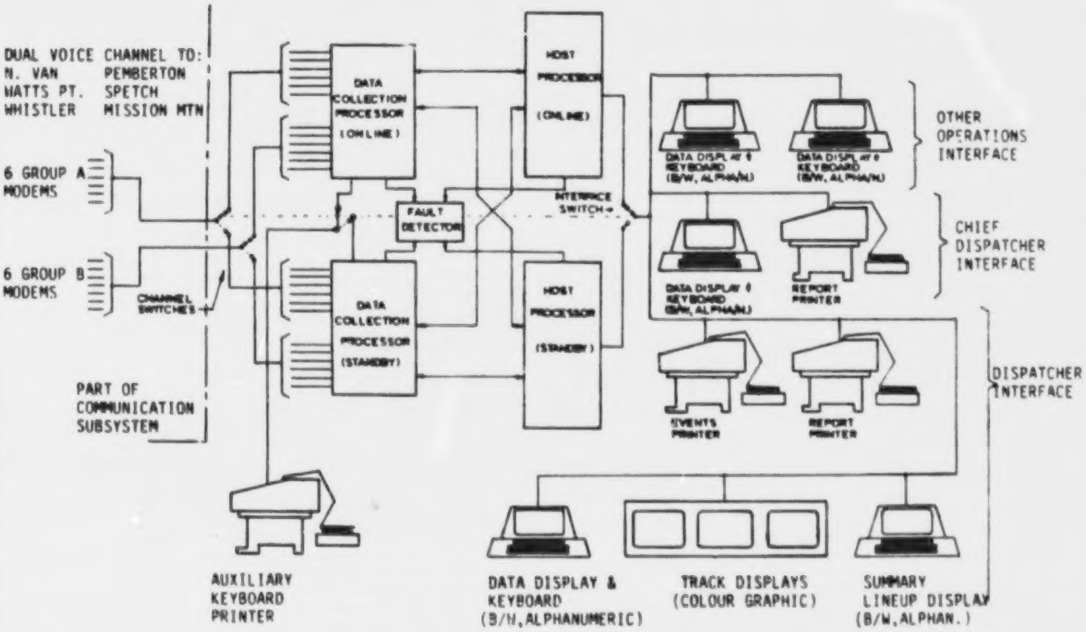

DUAL VOICE CHANNEL TO:
N. VAN
WATTS PT.
WHISTLER
PEMBERTON
SPETCH
MISSION MTN
6 GROUP A MODEMS
6 GROUP B MODEMS
CHANNEL SWITCHES
PART OF COMMUNICATION SUBSYSTEM
DATA COLLECTION PROCESSOR (ONLINE)
DATA COLLECTION PROCESSOR (STANDBY)
FAULT DETECTOR
HOST PROCESSOR (ONLINE)
HOST PROCESSOR (STANDBY)
INTERFACE SWITCH
DATA DISPLAY & KEYBOARD (B/W, ALPHA/N)
DATA DISPLAY & KEYBOARD (B/W, ALPHA/N)
OTHER OPERATIONS INTERFACE
DATA DISPLAY & KEYBOARD (B/W, ALPHA/N)
REPORT PRINTER
CHIEF DISPATCHER INTERFACE
EVENTS PRINTER
REPORT PRINTER
DISPATCHER INTERFACE
AUXILIARY KEYBOARD PRINTER
DATA DISPLAY & KEYBOARD (B/W,ALPHANUMERIC)
TRACK DISPLAYS (COLOUR GRAPHIC)
SUMMARY LINEUP DISPLAY (B/W,ALPHAN.)

FIGURE 2-2 LIC CENTRAL COMPUTER SUBSYSTEM

The Train Subsystem includes train-mounted processing and communications hardware as well as Digitrac transponders placed on the roadbed at each point at which positive train identification is required. Such points are referred to as Control Points. The Engine Logic Unit (ELU) is the heart of the locomotive equipment. It accepts transponder identifiers from the Digitrac interrogator mounted on the underside of the engine and maintains an accurate odometer based on an axle pulse generator. The ELU also responds to polling requests from the DCP, returning status information and decoding and acknowledging dispatcher instructions. The instructions are sent to the locomotive Cab Display Unit (CDU) along with the odometer reading and current engine speed. Caboose mounted equipment is a subset of the locomotive equipment consisting of an ELU, interrogator, and radio. It is only capable of reporting transponder crossings.

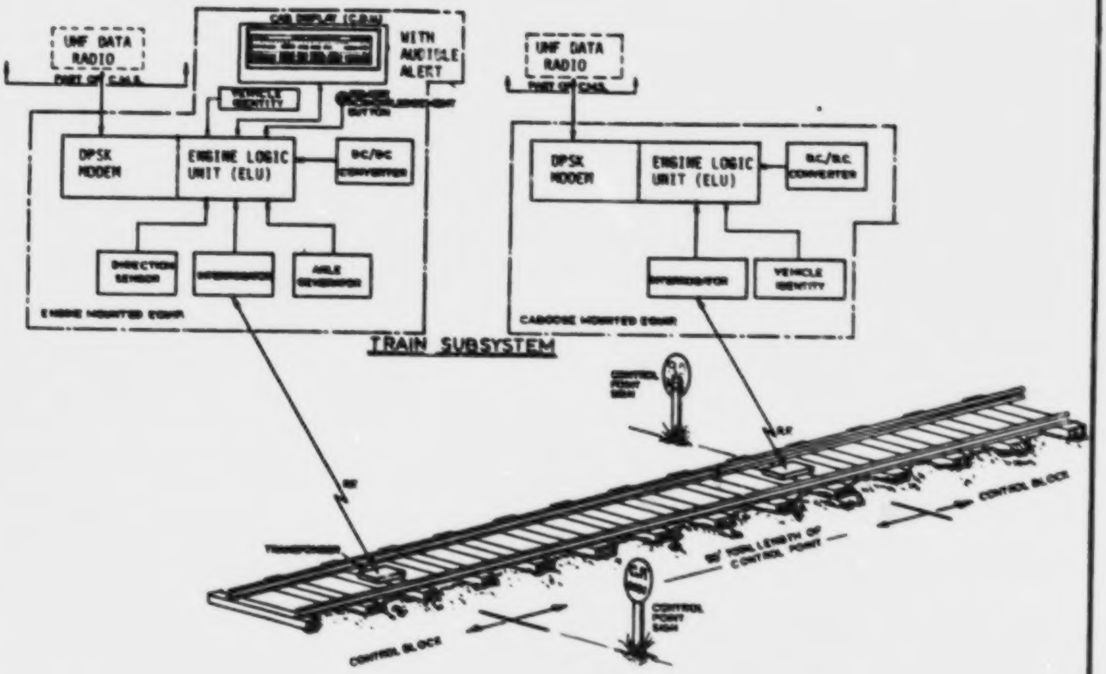
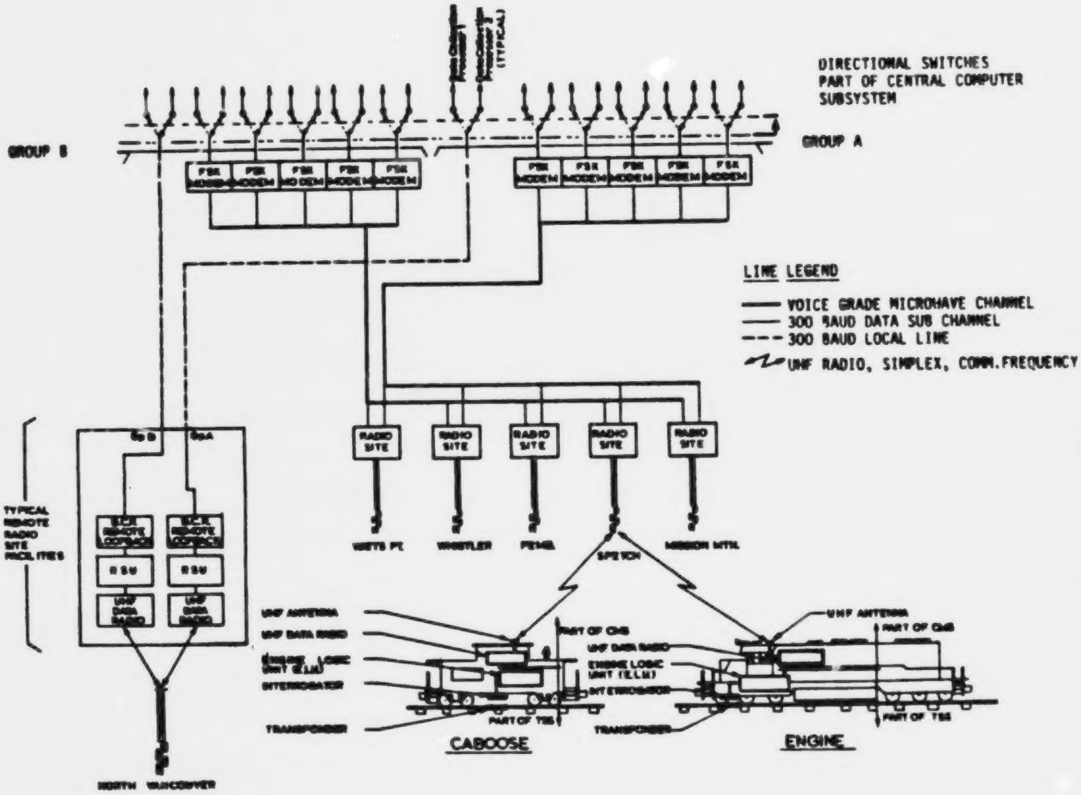

UHF DATA RADIO
WITH AUDIBLE ALERT
DPSK MODEM
ENGINE LOGIC UNIT (ELU)
DC/DC CONVERTER
DIRECTION SENSOR
AXLE GENERATOR
UHF DATA RADIO
DPSK MODEM
ENGINE LOGIC UNIT (ELU)
DC/DC CONVERTER
VEHICLE IDENTITY
TRAIN SUBSYSTEM
CONTROL POINT SIGN
RF
CONTROL BLOCK
CONTROL POINT SIGN
CONTROL BLOCK

FIGURE 2-3 LIC TRAIN SUBSYSTEM

The final major LIC subsystem is the Communications Subsystem (CSS) which provides the link between the other two. The backbone of CSS is a microwave trunk and landline links between the central office and a number of remote sites. UHF radio transceivers at each remote site communicate with any trains within range. The DCP is responsible for selection of the best remote site for each train according to location. A highly secure communications protocol ensures the integrity of the digital messages exchanged.



(TYPICAL)
DIRECTIONAL SWITCHES
PART OF CENTRAL COMPUTER
SUBSYSTEM
GROUP B
GROUP A
FSK MODEM
LINE LEGEND
VOICE GRADE MICROWAVE CHANNEL
300 BAUD DATA SUB CHANNEL
300 BAUD LOCAL LINE
UHF RADIO, SIMPLEX, COMM.FREQUENCY
Gp B
Gp A
TYPICAL REMOTE RADIO SITE FACILITIES
B.C.R. REMOTE LOOPBACK
RSU
UHF DATA RADIO
NORTH VANCOUVER
RADIO SITE
WATTS PT
WHISTLER
PEMB.
SPETCH
MISSION MTN
UHF ANTENNA
UHF DATA RADIO
ENGINE LOGIC UNIT (E.L.U.)
INTERROGATOR
TRANSPONDER
PART OF CMS
PART OF TSS
CABOOSE
ENGINE

FIGURE 2-4 LIC COMMUNICATIONS SUBSYSTEM

2.2 Train Control

2.2.1 Introduction

Under LIC Train Control it is the responsibility of the train dispatcher to issue movement and track occupancy authorities to trains, track vehicles, and maintenance of way personnel. The Host computer system provides the information display and data entry facilities necessary for this dispatcher activity. In addition, the Host checks every authority for consistency and potential conflicts before it is issued or cancelled. Further independent checks are carried out by the DCP which then supervises an exchange of messages with the train affected.

The remainder of this section describes the control functions available to the dispatcher, the authority checks made by the Host computer, and the Host data entry and display facilities used in train control.

2.2.2 Train Control Functions

This subsection outlines the functions and directives available for LIC Train Control. The train dispatcher chooses functions and enters information by means of the special function keyboard described in Subsection 2.2.5. Details of the data which must be entered to perform each function are described in this section, (1) through (17). The reader is also referred to the LIC Operating Rules contained in Appendix C.

The Train Control functions may be grouped into four areas. The first comprises six functions used to issue authorities and directives related to train movement:

1. CAB DISPLAY AUTHORITY: Entered via the special function keyboard and transmitted to the ELU of the designated engine. The ELU can hold a maximum of six authorities, no more than three of which are visible to the engineman at any one time. Each authority permits the engine to cross a single specified control point (CP) and may belong to one of three categories:

    - Routing authority, which allows the train to cross the designated CP in a specified route and direction (e.g., Main North). Authority is fulfilled and automatically removed from the cab display ("rolled up") when the lead engine has crossed the CP. Up to six routing authorities may be held by a train at any time, and the CPs specified must be sequential.

- Restricted routing authority, which allows the train to cross the designated CP in a specified route and direction, but only at restricted speed. The authority is fulfilled when it is removed by the dispatcher. If a train holds restricted routing authority, then it may hold no other authority. A train may hold no more than one restricted routing authority at any one time.

- Switching authority, which allows the train to cross one designated CP in either direction and to occupy one block on either side of the CP. The authority is fulfilled when it is removed by the dispatcher. A train holding a switching authority may not hold any other authority.

2. WRITTEN ROUTE AUTHORITY: Supersedes cab display authority and may be used when for any reason a train cannot be given cab display authority (LIC Operating Rules 901-910 apply). To issue a written route authority, the dispatcher enters the same data as required for cab display routing authority. The Host, after performing the usual checks, assigns a sequence number for the authority, and the dispatcher can then transmit the authority to the conductor or engineman by voice radio. A written authority must be correctly repeated and the dispatcher's "Complete" time and initials properly acknowledged. A written restricted route authority allows movement at restricted speed only, and a train may hold such authority over no more than one CP at a time.

3. WRITTEN OCCUPANCY AUTHORITY: Allows the dispatcher to provide occupancy permits for trains and/or maintenance of way crews using the main track. LIC Rules 905-909 cover the four categories of written occupancy authority:

   Exclusive - allows one train exclusive work authority between designated control points; the train may move in either direction.

   Dual - allows two trains to work within the same limits, protecting against each other.

   Joint - allows one train and a maintenance of way crew to occupy main track between the designated control points.

   Exclusive Maintenance - gives a maintenance of way crew exclusive authority between control points.

4. DIRECTIONAL BLOCKING: Allows the dispatcher to restrict train movements in one or both directions over a designated control point. This function does not grant authority to any train or maintenance of way crew. Directional blocking remains in force until it is removed by the dispatcher.

5. MANUAL OS: Allows the dispatcher to enter data not otherwise available through the LIC System. The entries provided for are:

   - CP crossing by an engine.
   - CP crossing by an end of train unit.
   - Confirmed switch alignment at CP.

The first two would be used typically in the operation of a non-LIC equipped train.

6. ISSUE OCCUPANCY: Allows the dispatcher to enter information which defines the occupancy of a block. This function does not contain or imply any authority. A typical use would be to protect cars stored in a siding.

The second group comprises seven Train Control functions used to cancel or remove previously issued authorities:

7. CANCEL CAB DISPLAY AUTHORITY: May be used to remove any authority currently held by an ELU, subject to the following restrictions:

   - When more than one authority is held by an ELU, only the last issued authority may be cancelled; the function may be repeated for the same train if it holds more than one authority.

   - If the authority is visible on the cab display, then the engineman must operate the Acknowledge button before it may be cancelled.

The train concerned remains protected within the block(s) it occupies ("Computer Protect").

8. CANCEL WRITTEN ROUTE AUTHORITY: Is used to cancel an unfulfilled written route authority or to remove a fulfilled restricted route authority (LIC Rule 804 applies). The conductor or engineman concerned must concur with the intended cancellation and must acknowledge the time of the cancellation to the dispatcher. The train retains computer protection.

9. CANCEL WRITTEN OCCUPANCY AUTHORITY: Is used similarly to cancel a written occupancy authority. All parties concerned, i.e., conductors, enginemen, and foremen, must concur and must acknowledge the cancellation time.

10. REMOVE DIRECTIONAL BLOCKING: Is used to remove directional blocking from a control point upon specification of the CP and the direction blocked.

11. MANUAL OVERRIDE: Is used by the dispatcher to cancel or remove all cab display authorities from a specific train in the event of ELU or communications failure. Note that the authorities are removed from the central office computers but could remain visible on the cab display. LIC Rule 901 applies and allows the engineman to ignore the cab display and proceed on written authority.

12. CANCEL COMPUTER PROTECT: Allows the dispatcher to remove all or part of the computer protection which is left in force when authorities are removed from a train. The dispatcher must ascertain previously from the conductor or engineman concerned that protection is no longer required.

13. REMOVE OCCUPANCY: Used to delete information defining block occupancy. See ISSUE OCCUPANCY above.

Two functions allow the dispatcher to issue or cancel directives to the engineman:

14. CALL DISPATCHER ON (OFF): Allows the dispatcher to issue (cancel) a request for the engineman to make contact by voice radio.

15. ACKNOWLEDGE WHEN READY: Issues a request to the engineman to actuate the ELU's "ACK" button when ready to proceed. This function would be used when a train first enters LIC territory.

Finally, two functions are provided for the dispatcher's use in special circumstances:

16. ALARM ACKNOWLEDGE: Allows the dispatcher to stop the violation alarm indication on the graphics display for a specified train. The alarm will still appear on subsequent violations.

17. FORCE FAIL: Allows the dispatcher to force the ELU in a designated unit into a failed state. The ELU addressed will not be available after this directive has been issued. A technician is required to restore the ELU to an operable condition.

2.2.3 Conflict Detection

An essential feature of a train control system is its ability to maintain operational safety. In the LIC System, the Host computer ensures that the dispatcher is prevented from issuing or removing authorities when such action would result in a conflict situation. A second level of security is provided independently by the DCP.

The Host maintains a record of all current authorities. If a new authority is to be accepted or an existing authority removed, then the Host must carry out rigorous checks. The checks ensure first that all prerequisite conditions have been met, and second that no conflict situation will arise when the train complies with the authority.

Specific prerequisite and conflict checks have been established for each Train Control function. These checks are based on the following general conditions:

- Conflict control does not apply to sidings or switching zones; trains in these areas are restricted by rule.

- A train may not be given authority to operate in LIC territory until the train sheet has been set up and the train is shown on the summary lineup.

- When a train is issued unrestricted authority to enter a block, the train must have exclusive use of that block.

- When a train is issued restricted routing authority into a block, there must be no opposing movements in the block.

- When a train is issued cab display restricted routing or switching authority, no other unfulfilled authorities may be held by the train, nor may further authorities be issued until the restricted routing or switching authority is removed.

- Routing authorities must appear on the cab display such that they can be fulfilled in the sequence shown without additional authority. A new authority always will become the last of that sequence.

- Written authority will supersede all other forms of authority for the blocks a train currently occupies.

- A train will be assumed to occupy all blocks included in the written authority.

- When any authority is cancelled the train will always be protected ("computer protect") in the blocks it occupies. This protection does not apply to maintenance of way crews working under Rule 906 authority.
- Any train detected moving across any control point will be checked to determine whether it is operating outside its authority.
- No main track movement may be authorized over a control point at a switch whose position is not verified as "lined to main".
- A train is considered to have fouled a control point if it reports crossing either or both transponders. The train has not cleared the control point until it has crossed both transponders.
- A block covered by computer protect or known to be occupied may not be authorized to another train.
- A train may be authorized to enter a siding or switching zone regardless of occupancy or authorities issued for that block.

2.2.4 Colour Graphics Display

The Host Colour Graphics Display has been described previously (1) as it functions in train tracking mode. When the Host system is operating in control mode, the graphics display shows the following information:

- A scale representation of the subdivision main track showing all stations, control points, sidings, and switching zones.
- The location, identity, and, depending on the type of authority held, the direction of motion of all LIC equipped trains.
- Authorities issued to trains by cab display or under Rules 904-909.
- The identities and work limits of maintenance of way crews with authorities issued under Rules 906 and 909.
- Directional blocking at control points.
- The inferred alignment of main track switches.

In the absence of train activity, the display shows all static data. The main track, sidings, and designated additional trackage are coloured white; blocks designated as switching zones are coloured cyan. When authority is issued to a train to enter or occupy a block, the block will be shown in a colour specific to the type of authority. If an authority

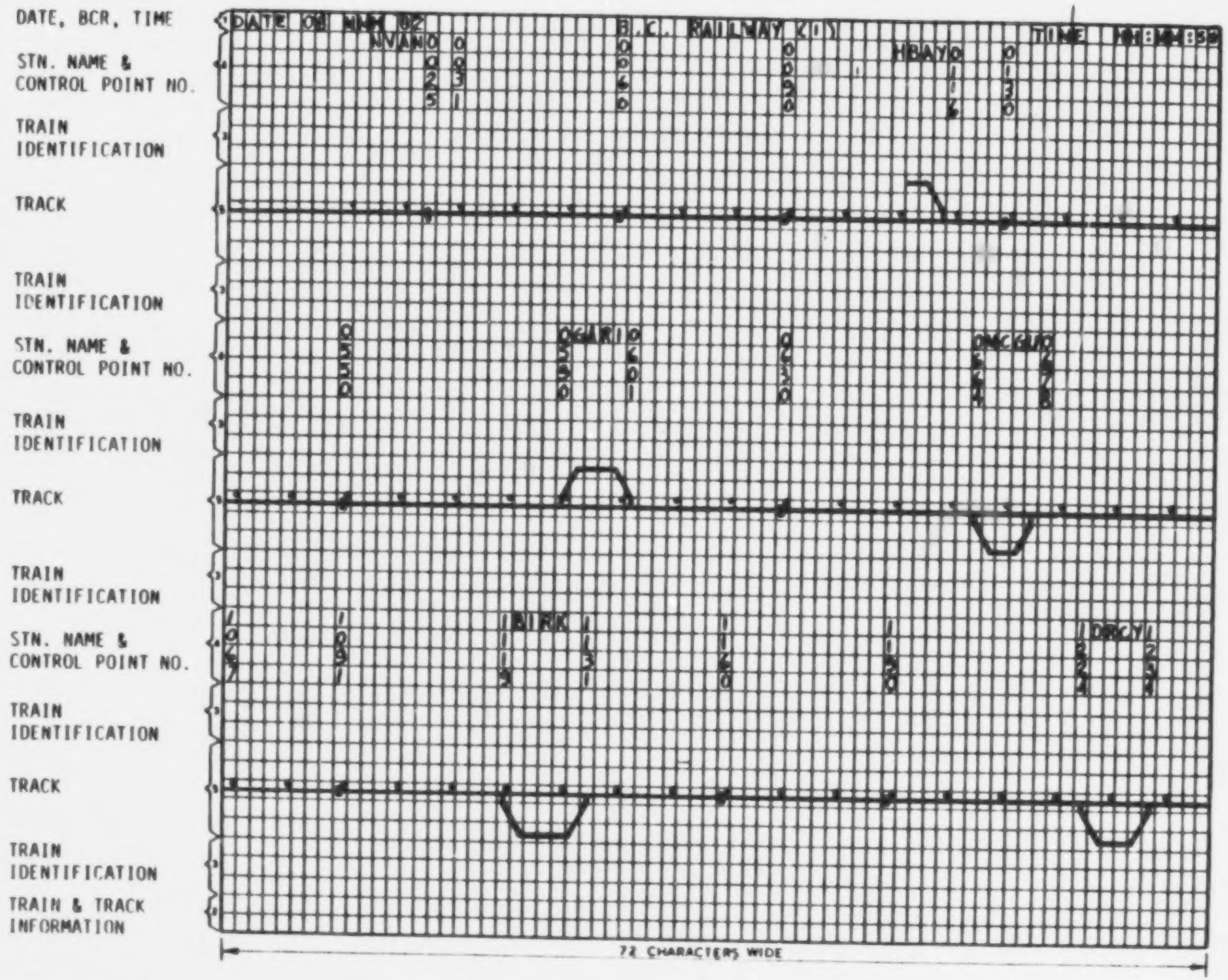

DATE, BCR, TIME
STN. NAME & CONTROL POINT NO.
TRAIN IDENTIFICATION
TRACK
TRAIN IDENTIFICATION
STN. NAME & CONTROL POINT NO.
TRAIN IDENTIFICATION
TRACK
TRAIN IDENTIFICATION
STN. NAME & CONTROL POINT NO.
TRAIN IDENTIFICATION
TRACK
TRAIN IDENTIFICATION
TRAIN & TRACK INFORMATION
DATE
B.C. RAILWAY
TIME
NVAN
HBAY
GARI
MCGU
BIRK
DRCY
72 CHARACTERS WIDE

FIGURE 2-5A

C.R.T. TRACK LAYOUT DIAGRAM

BC RAIL

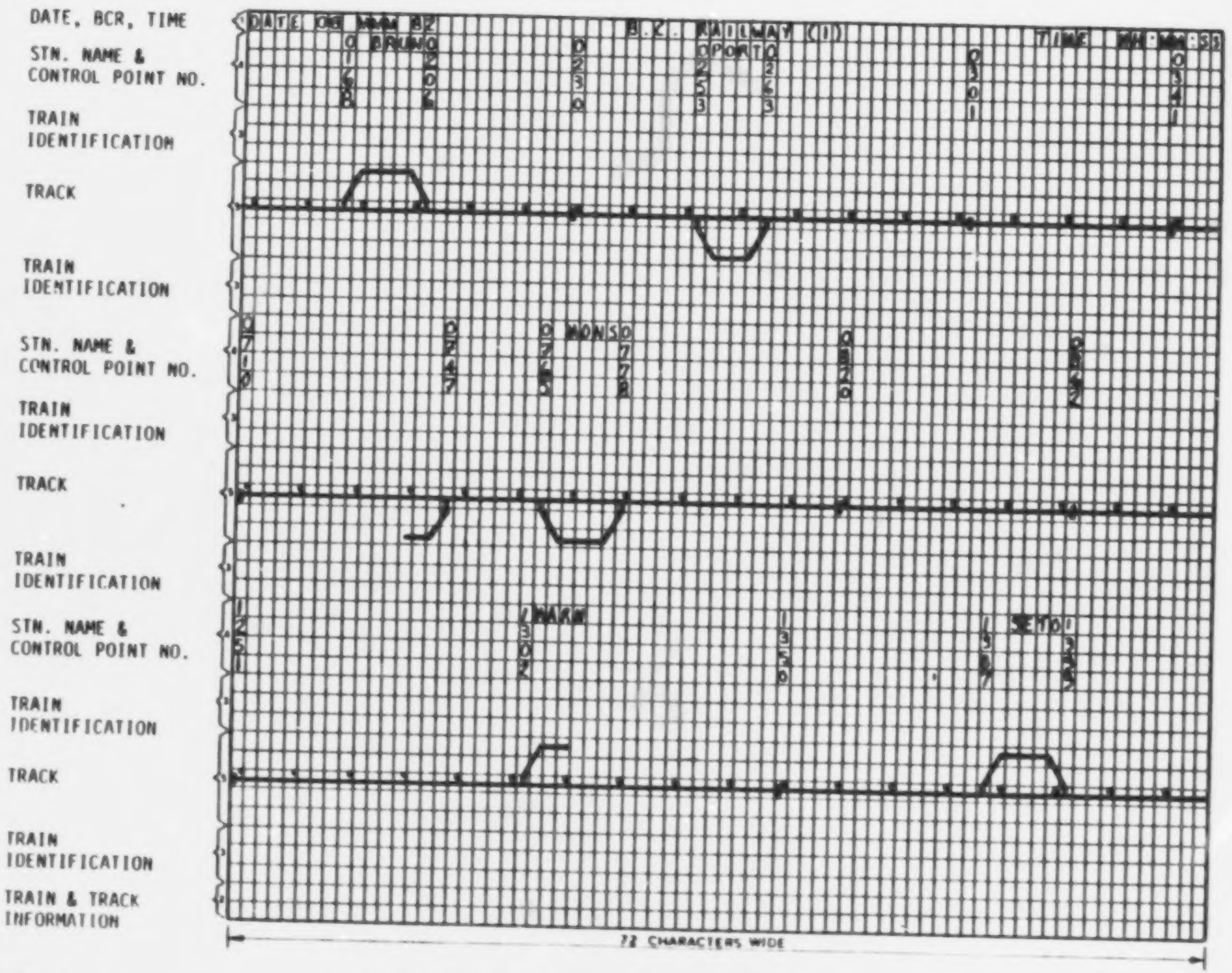

DATE, BCR, TIME
STN. NAME & CONTROL POINT NO.
TRAIN IDENTIFICATION
TRACK
TRAIN IDENTIFICATION
STN. NAME & CONTROL POINT NO.
TRAIN IDENTIFICATION
TRACK
TRAIN IDENTIFICATION
STN. NAME & CONTROL POINT NO.
TRAIN IDENTIFICATION
TRACK
TRAIN IDENTIFICATION
TRAIN & TRACK INFORMATION
DATE
BRUNO
B.C. RAILWAY (II)
OPORTO
TIME
MONSO
72 CHARACTERS WIDE

FIGURE 2-5B

C.R.T. TRACK LAYOUT DIAGRAM

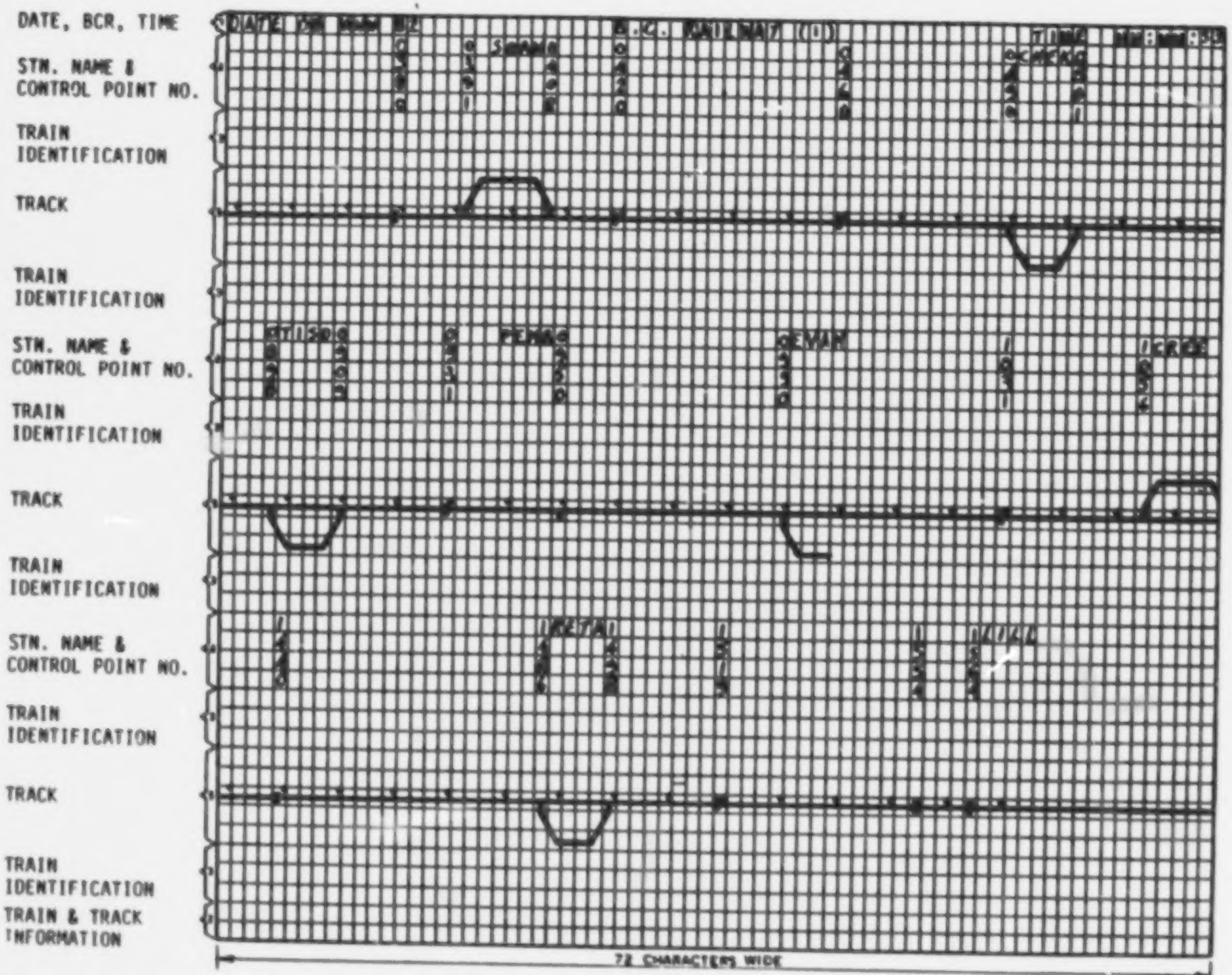

DATE, BCR, TIME
STN. NAME & CONTROL POINT NO.
TRAIN IDENTIFICATION
TRACK
TRAIN IDENTIFICATION
STN. NAME & CONTROL POINT NO.
TRAIN IDENTIFICATION
TRACK
TRAIN IDENTIFICATION
STN. NAME & CONTROL POINT NO.
TRAIN IDENTIFICATION
TRACK
TRAIN IDENTIFICATION
TRAIN & TRACK INFORMATION
72 CHARACTERS WIDE

FIGURE 2-5C

C.R.T. TRACK LAYOUT DIAGRAM

has an associated direction, then an arrow of the same colour will appear at the leading end of the blocks. Table 2-1 summarizes the colour convention for each type of authority and dispatcher control function as laid down in the System specifications.

While the dispatcher is in the process of issuing or cancelling an authority, the block(s) covered by the authority will blink on the display. Blinking commences as soon as sufficient information has been entered via the special function keyboard. The display will revert to steady colour upon successful completion or abandonment of the function.

If a train violates its operating authority, its identification will change to blinking red inverse video, i.e., black characters on a red block. The dispatcher uses the ALARM ACKNOWLEDGE keyboard function to cancel this display.

	Item	Colour	Comments
1.	All main track & sidings	White	
2.	All main track & sidings in yard limits	Cyan	
3.	Cab display route main track	Green	Engine location displayed by odometer reading
4.	Cab display route siding	Cyan	"
5.	Written Route main track	Green	No engine location
6.	Written Route siding	Cyan	"
7.	Restricted route (cab display and written) main track only	Red	If cab display, engine location by odometer
8.	Cab display switching main track & sidings	Yellow	No engine location shown
9.	Written authority main track	Blue	No engine location shown
10.	Written authority sidings	Cyan	No engine location shown
11.	Computer protect main track	Orange	No engine location shown
12.	Computer protect siding	Cyan	No engine location shown
13.	Switch alignment	Magenta	Only when assumed other than main to main
14.	Directional blocking	Blue	Half diamond symbol shown
15.	Occupancy	Cyan	Cars on sidings etc.
16.	Engine location	Cyan	Designated by arrowhead
17.	Train identification (route authorities)	Green	
18.	Train identification (written occupancies)	Blue	

NOTE: When an authority has an associated direction, an arrow will be shown on the leading end of the blocks in the same colour as that of the authority.

While the dispatcher is issuing or cancelling authorities, the block(s) covered by the authority will blink on the display until successfully issued or cancelled.

A train which violates its operating authority will have its identification changed to red inverse video and will blink.

TABLE 2-1 GRAPHICS COLOUR CONVENTION TABLE

2.2.5 Special Function Keyboard

The Special Function Keyboard (SFK) is the dispatcher's primary means to enter train control information and instructions. The SFK was perceived initially as a specially designed and manufactured unit having its own microprocessor to encode commands and support communications with the Host computer. Individual buttons would represent train types, specific authorities, and other data.

As the LIC project progressed it became evident that a custom SFK would lack flexibility and that immediate technical support might not be always available in the case of a malfunction. The use of a standard VT-100 CRT terminal to provide backup SFK service was investigated. Project personnel subsequently decided that all SFK functions should be implemented in Host software. The dispatcher then may select a desired function from a VT-100 screen menu (Authority Data Menu, Table 2-2).

When no train control function is in progress, the blinking display cursor is placed in the upper left-hand corner of the screen, at item number 1 of the OPERATION column. The display shows the items available for selection at any time in reverse video. The dispatcher selects an option by pressing the corresponding key on the keyboard. The display will then highlight those entries which the dispatcher may next choose from for a valid sequence.

When the dispatcher has selected an OPERATION, e.g., ISSUE, the cursor jumps to the next location at which a selection can be made or data entered, in this example the FUNCTION column. The dispatcher selects a FUNCTION, e.g., CAB DISPLAY. The cursor jumps to IDENTITY, where the dispatcher enters the TRAIN identifier and CP number, then to ROUTE and DIRECTION. In each case the system will not accept invalid data.

When all of the necessary data have been entered the cursor jumps to the bottom of the screen and the system displays: EXECUTE (Y/N)? If the dispatcher presses "Y", then the system will attempt to execute the function requested. If the dispatcher presses "N", the system will abandon the operation and ignore all previous keyboard input. The dispatcher also may abandon an operation at any point by pressing the delete key, or another PF selection key.

AUTHORITY DATA

OPERATION

0	Issue
1	Cancel
2	Alarm Acknowledge
3	Issue O.S.
4	Cancel Comp. Protect
5	Manual Override
6	Forced Fail
7	Repeat
8	System Prompt
9	Clear System

FUNCTION

0	Cab display
1	Written Route
2	Train Occupancy
3	Dual Occupancy
4	Joint Occupancy
5	Maint. Occupancy
6	Directional Block
7	Occupancy
8	Ack When Ready
9	Call Dispatcher

IDENTIFICATION

0	Train
1	CP
2	Until
3	Time

ROUTE

0	Main
1	Siding
2	Restricted
3	Switching

SYSTEM

0	Error Message
1	Remove Last Entry
2	Delete Queue

O.S. TYPE

0	Engine
1	End of Train
2	Switch

DIRECTION

0	North
1	South
2	North/South

TEST ON SELECTIONS MADE

PF choices PF1 PF2 PF3 Execute Y/N

TABLE 2-2 S. F. K. MENU

2.3 Host-DCP Communications

Successful operation of the LIC System depends upon reliable communication of data between various processors. All data communication with train mounted equipment takes place between the ELUs and the DCP as previously described. The Host computer acquires data from and sends data to only the DCP.

2.3.1 Protocol

The DCP and Host processor communicate over an asynchronous serial data link at a rate of 9600 baud. The communications protocol is designed to ensure a high probability of detection of any error introduced into data transmitted across the link. BCH and parity bits appended to each message allow the system to detect all 1, 2, or 3-bit errors. The protocol also detects response timeouts, syntax errors, and errors in message context. If an error is detected in a message transaction, the Host may make up to 3 retries.

The protocol requires that the Host system control all communications activity and initiate all transactions. No more than one transaction may be in progress at any one time. Transmission of data or commands from the Host to the DCP takes precedence over data transmission from the DCP to the Host. The Host-DCP transactions are ordered by priority. Only one transaction may be in progress at any time.

2.3.2 Information from DCP

This subsection describes the transactions used by the Host to obtain data from the DCP. A complete transaction comprises two messages:

- a request for data sent from the Host to the DCP
- a response sent from the DCP to the Host.

In the event of either a timeout or an invalid response (BCH, syntax, or context error) the Host may retransmit the request. If the DCP receives an invalid request, it transmits an error acknowledgement, and the Host may retry the request. The message transactions which fall into this category are described below:

1. PRIORITY DATA REQUEST: Allows the DCP to communicate certain high priority information to the Host. It is issued by the Host every 2 seconds. A response to the priority data request may be one of four message types:

- New Provisional Status Report: Identifies the oldest unit which entered LIC territory via speak-up and is unknown to the Host; also informs the Host of any train for which data request has been made in at least five minutes.

- ELU Display Buffer Report: Details of the instructions held in the ELU buffer of the train indicated in a command issued by the Host (see 2.3.3).

- DCP/CSS Status Report: Informs the Host of the status of the on-line DCP (and backup DCP, if installed) and the DCP-ELU communications subsystem. Queued as priority data only if there is a change in DCP or CSS status.

- ELU Protocol Status Report: Indicates the status of the DCP-ELU communications transaction which resulted from a command issued by the Host (see 2.3.3).

When the DCP wishes to make one of these reports it queues a message to one of four buffers. On receipt of a priority data request the DCP transmits to the Host the oldest message in the highest priority buffer. This step is repeated until all four buffers are empty, at which time the DCP transmits a "no more data" response.

2. TRAIN STATUS REPORT: Is used by the Host to poll the DCP for operating data on each train known to the system. The request is issued approximately every 1.5 seconds if no higher priority activity is in progress. The interval between status requests for any given train depends on the number of trains on the Host's polling list. In response, the DCP reports the location, speed, and status (ELU, communications, calibration) of each unit (head-end, mid- and end-of-train) in the train specified. The report may contain data on up to twelve transponder crossings for each unit.

3. DCP AND CSS STATUS REQUEST: Permits the Host to monitor the operating status of the on-line and standby DCPs and the Communications Subsystem. It is transmitted at intervals of 3 seconds. The above three request messages and the DCP responses to them form the base idle load on the Host-DCP communications link. All of the polling intervals mentioned may be altered in the Host software.

4. OTHER REQUESTS: Are used by the Host to examine the DCP's train list and the contents of its authority and occupancy databases. The primary use of these messages is to verify that a DCP has been correctly initialized.

2.3.3 Commands

The DCP-ELU transaction used in transmission of a command (CP instruction or directive) to an ELU follows the four-step sequence described below:

1. REQUEST: The Host transmits a command message to the DCP. If the DCP receives the message without syntax, context, or transmission error, then it checks its own train database for conflicts, and transmits the command to the ELU.
2. CONFIRM: If no error or conflict is detected, the ELU translates the command into a new format and echoes it back to the DCP.
3. EXECUTE: If the DCP receives the echoed command without error, and the reformulated version is correct, then it sends an Execute message to the ELU.
4. ACKNOWLEDGE: If the ELU receives the Execute message without error, then it sends a positive acknowledgement to the DCP. The DCP informs the Host of the success or failure of the transaction by means of a priority ELU Protocol Status report.

If the DCP detects an error in the above exchange, then it will transmit the appropriate negative acknowledgement to the Host. The DCP may retry up to 3 times; if all attempts fail, it records the failure as a significant event and alerts the dispatcher. If the DCP detects a conflict, it will report this fact in a negative acknowledgement. The Host will record a significant event and alert the dispatcher.

2.3.4 Information to DCP

The Host will send data to the DCP both at initialization time and whenever it is necessary to update the latter's database. The information sent to the DCP falls into one of two categories: general system data needed by the DCP, and train operating data required for the DCP's tracking and conflict detection functions.

If the Host receives a DCP/CSS Status report which indicates that the DCP is not initialized, then it will transmit the following data to the DCP (preceded by an Initialization Begins message):

1. Track Model Data - describes the location, identification number, and operating parameters of each transponder in the system.

2. Unit ID List - associates the identification code of each ELU with the number of the BC Rail unit on which it is mounted.
3. Communications Coverage Model - defines the northern and southern limits of radio coverage of each communications site in terms of subdivision mileage.
4. DCP and CSS Status Update (optional at initialization) - allows the Host to control some aspects of DCP and CSS operation.
5. Train List Update (optional at initialization) - allows the Host to update the DCP's polling list of trains; the Host may add a new train, delete a train, or modify the data pertaining to a train on the list.
6. Train Occupancy Update (optional at initialization) - informs the DCP of a change in block occupancy (block occupied or block cleared) by a train; used to transmit the result of a Manual OS to the DCP.
7. Authority Update (optional at initialization) - informs the DCP of the addition or deletion of an authority for a train or maintenance of way crew; used to transmit a written authority or occupancy to the DCP.

The Host indicates the end of the DCP-initialization sequence with an Initialization Ends message. After the DCP has been initialized, the Host may send any of the above messages whenever it is necessary to update this information.

2.4 Locomotive Cab Display

The Cab Display Unit (CDU) conveys authorities and other operating information to the engineman. It is located in the engine cab and is active only on the lead unit of a train. The CDU incorporates both an audible alert and an externally-mounted ACKNOWLEDGE pushbutton switch.

The alphanumeric display comprises six lines of up to 40 characters. It is divided into four regions:

- Region 1 - Engine speed, reported to the nearest 0.1 mph and updated approximately once per second. (See Figure 2-6).

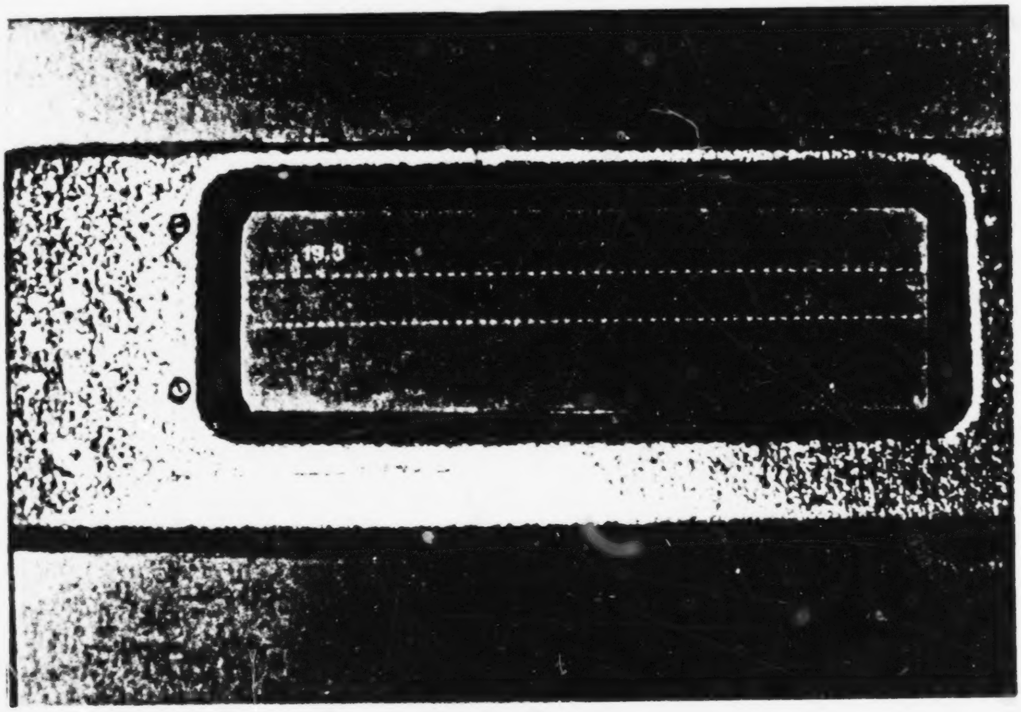


FIGURE 2-6 SPEEDOMETER LOCATION ON CAB DISPLAY UNIT

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- Region 2 - Location, i.e., mileage on the subdivision, reported to the nearest 0.1 mile and updated approximately once per second; shown only if the engine odometer is calibrated. (See Figure 2-7)

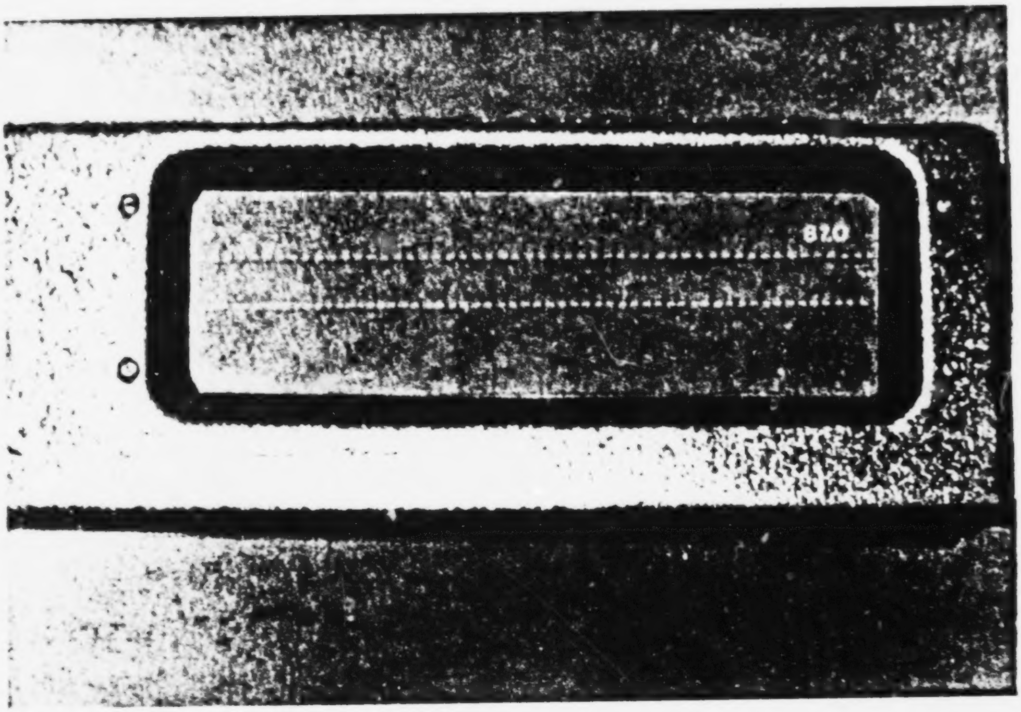

FIGURE 2-7 ODOMETER LOCATION ON CAB DISPLAY UNIT

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BC RAIL

- Region 3 - Operating Directive - see below.
- Region 4 - Operating Authorities - see below.

2.4.1 Operating Directives

Operating directives which do not directly affect a train's authority are displayed in a 29-character region on line 1 of the display. (See Figure 2-8).

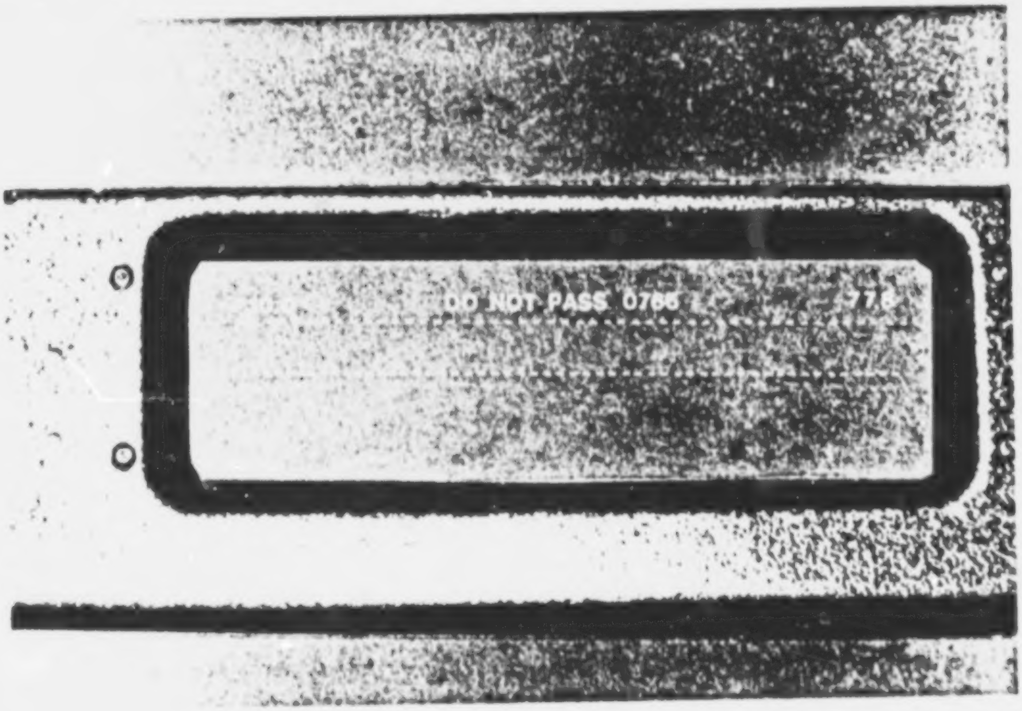

FIGURE 2-8 DIRECTIVE AREA ON CAB DISPLAY UNIT

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Most directives are accompanied by an audible alert and require that the engineman actuate the pushbutton switch in acknowledgement. If no directive is outstanding the Region shows the characters B C RAILWAY. The 7 possible directives are described below:

1. DO NOT PASS CPXXXX is set by the ELU and is displayed when a train travelling under routing authority has fulfilled its current authority and has no further authorities in its ELU instruction buffer. DO NOT PASS also appears if the train enters a siding and there is a control point (CP) at the other end of the siding leading back to main track. In both cases CPXXXX refers to the next control point ahead of the train. DO NOT PASS CPXXXX disappears upon display of a valid CP instruction.

2. CALL DISPATCHER is accompanied by an audible alert and must be acknowledged; it requests that the engineman contact the dispatcher by voice radio. CALL DISPATCHER can overwrite DO NOT PASS, but the latter directive will reappear after the engineman's acknowledgement.

3. ACKNOWLEDGE WHEN READY is issued by the dispatcher to a train prior to the start of its run. It is accompanied by an audible alert. The engineman acknowledges the directive when he has completed his pre-run duties and the train is ready to proceed.

4. MANUAL OS requests the engineman to confirm crossing the CP named in the current operating instruction (see below). The dispatcher would issue this directive if the ELU in question had failed to detect either of the transponders at the control point.

5. INSTRUCTION REMOVE requests that the engineman concur in the removal of an operating instruction from the display. (A displayed instruction cannot be removed without the engineman's acknowledgement - see below.)

6. LIC SYSTEM FAULT is set by the ELU if it detects a failure in the interrogator, odometer, or direction indicator. This directive is accompanied by an audible alert and requires the engineman's acknowledgement. The ELU also reports the fault to the central computer. If a DO NOT PASS directive is overwritten by LIC SYSTEM FAULT, it will reappear after the latter is acknowledged.

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7. ILLEGAL ENTRY is the highest-priority directive and will overwrite anything else displayed in Region 3. The ELU will cause it to be displayed immediately if the engine crosses a control point for which no valid CP instruction is displayed on the CDU. An ILLEGAL ENTRY violation also occurs if the engine crosses a transponder which is not one of those named in the current operating instruction. This directive is accompanied by an audible alert and must be acknowledged by the engineman. Upon acknowledgement of the violation the display will show ILLEGAL ENTRY ACKNOWLEDGED until it is cleared by the dispatcher.

2.4.2 Operating Authorities

Cab Display Region 4 conveys to the engineman any of three types of instruction which affect the operating authority of his train. Region 4 can display up to three authorities. The uppermost authority is the current instruction, while the lower two are future instructions and cannot be acted upon until the current instruction has been fulfilled or removed. The assignment of each of the five lines of Region 4 (display lines 2-6) is shown in Figure 2-9.

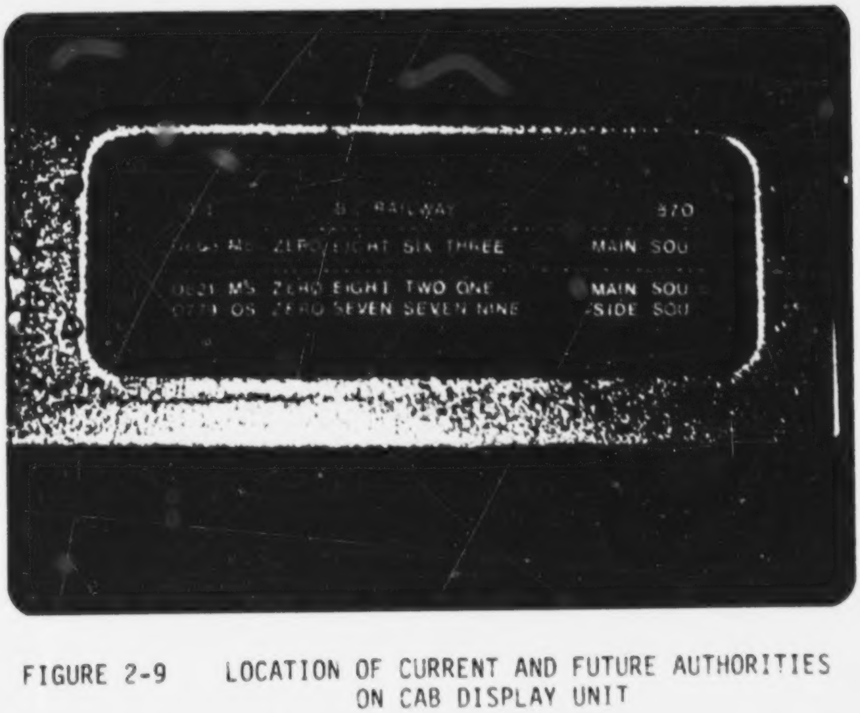

FIGURE 2-9 LOCATION OF CURRENT AND FUTURE AUTHORITIES ON CAB DISPLAY UNIT

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Lines 2 and 4 consist entirely of dashes and serve to delineate the current instruction displayed on line 3. Lines 5 and 6 contain the next two future instructions. (The ELU instruction buffer may hold up to 6 authorities, but no more than three may be displayed at once.)

The three forms of cab display instruction are:

1. CAB DISPLAY ROUTING - conveys authority to cross the indicated control point on the track designated and in the specified direction. The train may travel at track speed as far as the next CP but may not foul it. For example:

   0391MN ZERO THREE NINE ONE MAIN NTH

   instructs the train to cross control point 0391 on the main track in the northward direction. If the train were to take the siding, the CP instruction would read:

   0391DN ZERO THREE NINE ONE SIDE NTH

2. CAB DISPLAY RESTRICTED ROUTING - conveys authority to cross a CP as in (1), but train must travel at restricted speed. For example:

   0461RS ZERO FOUR SIX ONE RSTR SOU

   After a train has received Restricted Authority no other cab display operating authority may be issued to the train until the Restricted Authority has been fulfilled or cancelled.

3. CAB DISPLAY SWITCHING - authorizes a train to cross the designated control point in either direction and to occupy the blocks on either side of the CP. Switching authority applies to a single control point only. The train must occupy at least one of the adjacent blocks when the authority is issued and may hold no other operating authority. Movements must be made at restricted speed. For example:

   0391-SW ZERO THREE NINE ONE ---- SWG

LIC Operating Rules 805-810 further define the rights of trains operating under cab display authority.

2.4.3 Cab Display Data Security

It is vital to the safe operation of trains that CP instructions be displayed correctly in all respects and, if errors occur at any point, that they be detected and made known. Section 2.3 described the protocol used to communicate CP instructions from the DCP processor to the ELU. A similar double-handshake protocol governs communication of CP instructions from the ELU to the CDU. The final step in the process ensures that each instruction received by the ELU is displayed as it should be.

The CP instruction message received by the ELU consists of three parts: an encoded representation of the instruction; a redundant code formed by a mathematical transformation of the encoded instruction; and the numbers of the two transponders at the CP. Each form of the encoded instruction contains the CP number, route, and direction.

The character string which forms the actual displayed instruction comprises four substrings: the CP number in figures; an abbreviated route and direction; the CP number spelled out; and the route and direction spelled out. The characters and words which make up the substrings are stored in tables in ELU memory. The ELU uses various portions of the two encoded CP instructions as indices into these tables to construct two copies of the instruction as it would appear on the display.

One copy is transmitted to the CDU. When the CDU has received the entire character string it echoes it back to the ELU. The ELU then compares the echoed string with its own second copy of the instruction. If the two strings are identical, the ELU will allow the CDU to display the instruction; if not, the ELU will blank the display and report a CDU failure.

The final degree of display security stems from the fact that each displayed instruction contains the same information in both abbreviated and spelled-out forms. This duplication is analogous to standard train-order practice and depends on the person who reads the display to detect any disparity between the two forms.

3. EQUIPMENT INSTALLATION

The purpose of this section is to report the progress made towards completion of Milestones 16, 17, and 18 of the LIC contract work statement. Milestones 16 and 17 refer to the installation of ELUs and related equipment on engines and cabooses, respectively. Milestone 18 refers to the purchase and installation of all computer equipment required for train control.

3.1 Train Subsystem

The present configuration of the BC Rail LIC System permits a total of 66 distinct ELU identifiers. BC Rail has assigned 36 ELUs to engine service and 30 to caboose service. The Railway has completed the installation of LIC equipment on all 66 units.

The contract work statement also stipulates that all necessary spares and maintenance manuals be furnished at this time. BC Rail has not yet received final copies of these documents from the subcontractor.

3.1.1 Engines

The LIC equipment on each engine comprises the following items:

- Engine Logic Unit (ELU)
- Interrogator Coil Unit (ICU)
- Cab Display Unit (CDU)
- Axle pulse generator
- UHF radio transceiver and antenna

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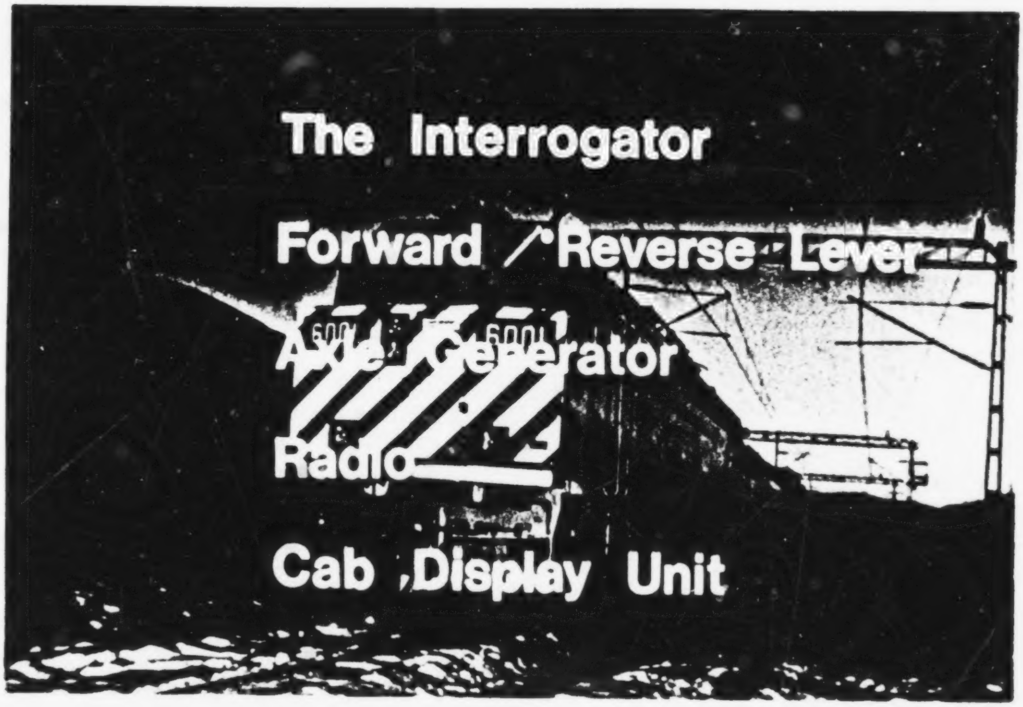
The Interrogator
Forward / Reverse Lever
Axle Generator
Radio
Cab Display Unit
6001
6001

FIGURE 3-1 EQUIPMENT INSTALLED ON ENGINE

BC Rail has installed LIC equipment on 30 freight engines, 5 passenger units (RDCs), and 1 track inspection vehicle. One set of engine equipment has been reserved temporarily for bench tests. Table 3-1 lists the BC Rail engines which have been LIC-equipped.

After some initial ICU mounting problems were solved through development of a suitable fixture, installation on RDCs and RS-30 freight units was completed without further difficulty. The longer wheelbase of the GF-30 trucks, however, forced the Railway to redesign the ICU mounting base for use on engines 751-756.

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UNIT	TYPE		NOTES
701	RS-30	(freight)	
702	"	"	
703	"	"	(1)
704	"	"	(1)
705	"	"	
706	"	"	
707	"	"	
708	"	"	
709	"	"	
710	"	"	(1)
712	"	"	(1)
713	"	"	(1)
714	"	"	
715	"	"	
716	"	"	
717	"	"	(1)
718	"	"	(1)
719	"	"	(1)
720	"	"	(1)
721	"	"	(1)
722	"	"	(1)
723			(3)
726	"	"	(2)
730	"	"	(2)
751	GF-30	"	(1)
752	"	"	(1)
753	"	"	(1)
754	"	"	(1)
755	"	"	(1)
756	"	"	(1)
BC10	RDC	(Budd car)	
BC11	"	"	
BC12	"	"	
BC30	"	"	
BC31	"	"	
V-10	Track inspection vehicle		

NOTES: (1) Equipped with LOCOTROL for lead unit operation.
(2) Equipped with comfort cab.
(3) LIC equipment intended for this unit currently used for bench testing.

TABLE 3-1 BC RAIL LIC-EQUIPPED ENGINES

3.1.2 Cabooses

The LIC equipment on each caboose consists of the following items:

- Engine Logic Unit (ELU)
- Interrogator Coil Unit (ICU)
- UHF radio transceiver and antenna

The 30 caboose which have been LIC-equipped comprise units 1854-1868 and 1870-1884. No significant problems were encountered in this work.

3.2 Central Computer Subsystem

The central office computer equipment required for train control comprises duplicate Host/DCP processor pairs, various peripherals, and the equipment used to interconnect these devices (see Appendix A).

Installation of the CCS hardware has been completed with the exception of two items: the second DCP and the Fault Indicator panel (see 3.2.1 below). The system is operating currently in the single processor configuration. Development of the Host and DCP software necessary to support dual processors has been deferred under an agreement with TDC (see 3.2.2 below).

3.2.1 CCS Hardware

The list below gives a breakdown of the CCS hardware installation:

(1) HOST PROCESSORS - two DEC PDP-11/44 computers have been installed complete with disk drives, serial line multiplexors, parallel ports, and cartridge tape drives. One system is used for LIC operations, while the other is currently inactive.

(2) DATA COLLECTION PROCESSORS - one DCP is in place and used for LIC operations at BC Rail. The second DCP has been retained temporarily by Glenayre Electronics for testing and development purposes.

(3) FAULT INDICATOR PANEL - the original unit was found to be inadequate, and BC Rail has undertaken to redesign it. The revised Fault Indicator will be installed prior to testing of the dual processor software.

(4) SPECIAL FUNCTION KEYBOARD - the SFK has been implemented as a software function in the Host computer (see 2.2.5) and is fully operational. The dispatcher enters train control information

via a standard VT-100 CRT terminal. The advantages of this method as opposed to use of a custom keyboard are twofold: all dispatcher data entry procedures are consistent; and a replacement terminal is immediately available in the event of malfunction.

(5) PERIPHERALS - the following displays, terminals, and printers have been installed in the LIC central office:

- 4 Aydin 8025 19-inch colour monitors (3 in operation; 1 in reserve)
- DEC VT-100 video display terminals
- DEC LA-120 printing terminals.

The above peripherals have been placed in various locations within the central office.

3.2.2 Dual-processor Software

In a fully operational LIC system, detection of a fault in the on-line Host or DCP will initiate an automatic switchover to the standby processor(s). It is the responsibility of the dual-processor software to recognize a fault when it occurs and then carry out the switchover securely and safely. To ensure a minimum delay, the standby Host and DCP databases must be maintained current to within 1 minute of their on-line counterparts.

The original work statement called for the implementation of dual-processor software at Milestone 21, i.e., prior to the start of parallel (LIC-train order) operation. In view of the project delays encountered to date with a single-computer CCS configuration, BC Rail has negotiated with TDC and the subcontractors to defer this requirement. This change will permit the Railway to commence parallel operation and gain some operating experience with the system. The system must be operating in full dual-processor configuration, however, before it can be accepted for stand-alone operation (Milestone 24).

4. LIC OPERATING RULES

4.1 Objectives

Milestone 19 of the LIC contract work statement required BC Rail to develop a comprehensive set of LIC operating rules. The primary purpose of the Uniform Code of Operation Rules (UCOR) is to ensure safety. When additional rules are written, e.g., for LIC operation, they must define the necessary terms and procedures completely, succinctly, and unambiguously.

The new rules may supersede certain portions of UCOR within the territory affected, but "all other UCOR rules remain in effect" (Rule 801, paragraph 3). The authors must be careful to ensure that none of the new rules reiterates an existing rule which is still in effect or supersedes an existing rule unnecessarily. If this redundancy were to occur, it would create the possibility of conflicting interpretations. Section 4.3 describes a case in which a potential LIC rule was rejected in favour of an existing rule.

4.2 Development

In 1976, the BC Rail Rules Department drafted an initial set of LIC Operating Rules which subsequently were appended to the LIC System Functional Specification. With the assistance of LIC development personnel, the Rules Department updated the original draft in April, 1982. The System Supervisor of Rules then coordinated a series of working committee meetings with Operations supervisory personnel throughout the system in order to fine-tune the LIC rules.

The resulting version of the LIC rules, published in January 1984, is sufficiently complete to begin parallel operation (Milestone 23). The Rules Department will use the experience gained during parallel operation to determine the need for any further changes or additions. The final version of the LIC Operating Rules must be published before the start of stand-alone operation (Milestone 24). The Rules as currently developed are included in Appendix C.

4.3 Evaluation

BC Rail has made every effort to ensure completeness of the draft LIC Operating Rules. It is recognized, however, that the experience gained in parallel LIC - train-order operation may bring to light previously unforeseen situations. Those responsible will have to examine each such situation to determine whether or not it is covered by the present draft (or the existing UCOR). If the situation is not covered already in a manner that ensures safety at all times, then the LIC rules must be modified accordingly.

Two such situations have arisen in the course of testing.

(1) Manual override - this dispatcher function is used only in the case of ELU or communications failure or other exceptional circumstances. It removes a train's authorities from the Host computer, but not necessarily from the cab display. Before the dispatcher may issue a manual override, he must advise the engineman concerned. The train must be brought to a complete stop and not proceed until a new authority has been received. The draft LIC rules do not cover this situation adequately, so a rule will be added to clarify the proper procedure.

(2) Switch position indication - when a main track switch is aligned for the diverging route and a unit crosses the diverging route transponder, the colour graphics display marks the switch as not aligned main-to-main. To preserve route and track integrity the system will not give authority for main track movement over that switch until the train crew confirms that the switch has been restored and the dispatcher enters a switch OS.

This procedure was intended to apply only to movements under routing authority; however, it was found that the display indicated such switches in blocks occupied by trains under non-directional authority (switching or written occupancy). When the dispatcher cancelled the authority, he would have to confirm and OS the marked switch(es) as aligned main-to-main. Since UCOR Rule 104 states that "main track switches must be lined...for main track when not in use", a train crew complying with existing rules would not leave a switch open and request cancellation of switching authority or occupancy.

It was decided that no modification to the LIC rules was required. Furthermore, under the original specification the colour graphics display should not mark switches in blocks occupied under non-directional authority. The host software will be modified to reflect the specification.

5. CONTROL SOFTWARE

5.1 Installation and Testing

Installation of the LIC train control software commenced in December, 1982, and the initial software acceptance tests were completed in August, 1983. The work was divided into four stages of progressively greater software complexity and functional capability as follows:

(1) Straight-through control: Basic control functions, but no checks for conflicting train movement.

(2) DCP conflict: Conflict checking enabled in DCP software only.

(3) Host conflict: Conflict checking enabled in Host software only.

(4) Full system conflict: Conflict checking enabled in both Host and DCP software.

Test Series Name	No. of Tests	Software Version		Acceptance Dates (1983)
		Host	DCP	
Straight-through	87	3.1	6.01	May 1-5
DCP conflict	103	3.1	6.02	May 13-26
Host conflict	100	3.3	6.02	June 2-10
Full conflict	103	3.4	6.03,4	June 25-29
Host conflict	99	3.4(med.)	6.04	Aug. 10-18
Full conflict	103	3.41	6.05	Aug. 22-29

TABLE 5-1 MILESTONE 20 CONTROL SOFTWARE TESTS

A detailed test plan was drawn up for each of the above stages (see Appendix D). Table 5-1 lists the test stages and indicates the number of tests at each stage, the Host and DCP software versions installed, and their dates of acceptance. Two additional test stages were found necessary to resolve all of the problems encountered. On completion of the final test stage the LIC control software in both the Host and DCP had met all requirements of the acceptance test plan.

The initial tests were conducted both with the bench test train equipment (see Section 3.1.1) and with units in the field. An observer was on board the field unit as necessary to monitor the cab display. Many of the test procedures required that a train be in a specific position relative to a control point or to another train. Since the normal operation of the Railway could not be interrupted, it was often necessary to wait to perform such a test until the necessary condition arose. This problem led to delays in completion of certain tests.

In the second phase of control software acceptance testing, track inspection vehicle V10 and RDC (Budd car) BC30 were required to complete five trips each over the Squamish subdivision under simulated LIC control. These trips were intended to test the interaction of all components of the LIC system. Owing to the delays previously encountered, however, the second test phase could not commence until late in 1983, and the onset of winter conditions made it unsafe to operate the V10.

Several attempts were made to conduct test trips with the BC30 in normal passenger service. A cab display mounted in the baggage compartment of the RDC was monitored by supervisory personnel.

5.2 Tests Results

The purpose of this section is to describe the test results and performance of the train control and conflict software package in an operational environment. The testing was conducted over a four month period from September 1983 until the end of December 1983.

Testing was accomplished by placing supervisory personnel on selected trains, and having them document all LIC transactions as they occurred. The on board supervisor measured LIC performance against LIC Operating Rules and actual operating requirements.

The second unit of the engine consist was set up for LIC operation during these field tests. The LIC central system was told the second unit was the lead unit. This allowed the supervisor to conduct his work without interfering with the regular train crew who were actually controlling the train's movement by train orders.

At Central, the LIC dispatcher monitored the Squamish subdivision train order dispatcher's voice circuit, and duplicated all train order movement authority by LIC. A chief dispatcher was assigned to specifically document the performance as the work at central was carried out.

At the end of the trip, field documentation, central documentation, system generated reports, and an evaluation summary were compiled into one document for historical reference.

5.2.1 Field Test Results

Field testing commenced in September 1983 and concluded the end of December 1983. Early test results were discouraging considering conflict control software had just completed an exhaustive set of acceptance tests (as described in Section 5.1). The primary difference between the acceptance tests and field testing was that acceptance testing involved 103 individual tests designed to prove the software capability of performing the function, while field testing resulted in constant combinations of those 103 tests.

The various combinations resulting from actual operating conditions created problems with the communications protocol between the various subsystem components.

Operational field testing over the four month period covered all of the following functions:

- issue and cancel cab display authorities
- enter and cancel written route and occupancy authorities
- issue and cancel directional blocking
- create and cancel occupancy
- manual O.S.
- issue and cancel directives to engineman
- cancel computer protect
- force fail

The results may best be expressed by reviewing two actual trip summaries, one from September 1983, and the other from December 1983. This will not only highlight slow but steady progress, but also the protocol problems referred to above.

LIC Milestone 20, Field Acceptance Testing, September 24, 1983

Assignment Details

Purpose

- Prove LIC train control functions by field testing in an operational environment employing a single host/DCP configuration. (As specified in BC Rail LIC system acceptance test plan, page 21, item 9.)

Authority

- LIC Project Manager - Mr. J.L. Voice

Personnel Assigned

- LIC Dispatchers Office - Mr. M.G. Brown
  Monitor Cab Display in the Field - Mr. P.D. Roy
  Technical Staff - As required

Date Involved

- September 24, 1983

Work Accomplished

Work Completed

- The test was conducted as follows: BC31 was equipped with a cab display unit, small table and a chair, in the baggage compartment. BC31 was included in the consist of number 1 in regular service from North Vancouver to Lillooet. At Lillooet BC31 was set out and run in regular service as number 2, Lillooet to North Vancouver.

- Mr. P.D. Roy travelled in the baggage compartment on the BC31, and documented all activities on the cab display unit for both legs of the journey.

- Mr. M.G. Brown dispatched BC31 both trips, and documented all activities in the dispatchers office. Copies of all test sheets, DCP/Host event printouts, train sheets, calibration and communications reports are on file in the dispatchers office.

Difficulties Encountered

- Written authorities had to be issued on the south trip between Garibaldi and North Vancouver, the reasons are currently under review. The problem seems to be related with control point instruction remove and directive timeouts in DCP with that particular train.

Specific Problem Areas

- Calibration was out of specification in both directions, two different wheel factors. Neither factor would be the correct factor for this unit.
- Communications average varied from 67% northward to 57% southward. The four weak communications areas are still evident.
- The LIC speedometer, when the train is coming to a stop, does not count down fast enough.
- Blocks in the DCP are not clearing when train exits block on written route authority.
- The cancellation of switching, not clearing the siding graphics properly.
- Continuous flashing of authority on graphics in one block when cab display authority was issued.
- Require "two call dispatcher directives" to be issued before indication appears on summary lineup.
- A cab display authority was received and displayed on cab display, but was not on graphics and not in DCP.
- Unable to issue cab display authorities over approximately 75 miles on account of control point instruction remove and control point - directive timeout in DCP.
- Dispatchers VT100 locked up.

Follow-Up Action Required

- This was trip one of five planned; because of the poor performance cancel remaining trips until control software more manageable, BC Rail action.
- Development team members carefully analyze all documented problems and assign priorities. Address high priority problems before future trips are planned, Glenayre/Datap/BC Rail action.
- Performance should have been better than achieved after time already dedicated to project, management monitor carefully.

LIC Milestone 20 - Field Acceptance Testing, December 8, 1984

Assignment Details

- Prove LIC Train Control functions by field testing in an operational environment employing a single Host/DCP configuration, (as specified in BC Rail LIC System Acceptance Test Plan page 21, item 9)(Test one of five planned for Budd Cars).

Authority

- LIC Project Manager - Mr. J.L. Voice

Personnel Assigned

- LIC Dispatch Office - North, M.G. Brown
  - South, J.D. Flanagan
- Ride Budd Car - P.D. Roy
- Technical Staff - D. Glenayre - BCR
  - B. Newton - BCR
  - A. Gau - Glenayre

Dates Involved

December 8, 1983

Work Accomplished

BC-31 travelled North Vancouver to Lillooet and return with ELU software version 2.7.7 and a modified cab display unit. The trip was considered a success and BC Rail will proceed with trip two.

Work Performed

- The following is a summary of control instructions issued during the trip:

Northward		Southward	
Acknowledge When Ready	1		
Call Dispatcher	6		
Manual OS Switch	2	Manual Override	2
Instruction Removed	8	Instruction Removed	3
Cab Display Route	48	Cab Display Route	41
CD Restricted Route	4	CD Restricted Route	1
Cab Display Switching	2	Cab Display Switching	1
		Written Route	2
		Exclusive Authority	1
Communications North	76%	Communications South	62.5%

- Calibration north, after wheel factor 244 obtained at mile 11.68 and mile 34.10 - four (4) simple calibrations. Maximum error .11 at mile 91.04, otherwise maximum error was .07. South factor 244 maximum error was .08. Note: The reason for the second full calibration at mile 34.10 was because the DCP was reset. The maximum error of .11 at mile 91.04 was most likely a brake application, (snow condition and slippery rail). The error between mile 98.97 and mile 91.04 varied from .03 to .11.

Difficulties Encountered

- The DCP crashed at 0850.

- We had a problem issuing cab display authority after restricted route was used and cancelled.

- The BC31 was involved in a three train meet, overtake and pass situation at Brunswick northward. The northward freight was too long for the siding. Actual field movements were made before the LIC dispatcher could issue authorities, and trains went into violation.

Follow-Up Action Required

- Update all ELU's with software version 2.7.7.
- Install modified cab display unit in engine 726 and evaluate performance.
- Correct outstanding DCP crashes.
- Update Host software to correct the cancel restricted route problem.

5.2.2 Conflict and Train Control Software Evaluation

In early testing the system had a problem validating and analyzing all train movement and control data. A good portion of these problems were created by the train dispatcher performing functions before previously issued functions were completed. This was a result of slower system operation than anticipated, and the dispatcher's eagerness to keep up with the trains, and lack of meaningful system generated condition codes.

At the end of the four month period we were only able to control trains by introducing the following:

> Imposing limitations on the use of some of the train dispatcher control functions, and reducing the amount of trains controlled at any one time on the subdivision to a maximum of five. The dispatcher was asked not to use restricted route, and limit the situations where he used cab display switching. He was also asked to exercise care, and be certain previously issued transactions were completed before proceeding with others.

When the system became inoperable as a result of the inability to process and complete all protocols between subsystem components, the Host and DCP normally had to be reset to recover. When the system was in the progressive degradation process of failing as a result of a protocol's problems, its inability to convey detailed error conditions to the dispatcher caused considerable frustration.

The evaluation of installing and testing conflict and train control software can be summarized as follows:

- The system could not meet original specification requirements and acceptance requirements.

6. SYSTEM DEVELOPMENT

On January 9, 1984 the LIC System commenced parallel operation and two weeks later parallel was terminated because of poor performance. The system was left in a holding pattern until an evaluation was conducted. This section deals with the evaluation of the system development rather than highlight the actual work attempted and its failure to perform.

From the point of view of the dispatchers using the system during the development period, the operational capability of the system varied from fair to poor. After the tracking functions of the system had been successfully demonstrated, progress in development became cyclic in nature. As problems in one area were identified and corrected, problems in other areas were uncovered. Although this kind of problem solving is not unusual in projects of this nature, the magnitude of the process was greater than that which even now should be reasonably expected. This was an organizational problem which, although causing schedule delays, did not directly result in termination of the project.

Four major functional problems ultimately caused the project to be terminated. These were:

(1) The DCP software was unable to correctly analyze all valid train movements.

(2) The DCP software was unable to operate for prolonged periods of time before its data base became corrupted.

(3) Communications with trains was too slow with only a few trains in the system.

(4) There were significant sections of track in which communication with trains was impossible.

Although these were the major reasons for not pursuing the project to completion, they probably represent only the remaining visible problems which confronted the project from its start. This section will attempt to identify the nature of the problems. There is no intent to lay blame or point fingers, only to identify the problems with the benefit of hindsight in the hope that they might be avoided in any future development.

It is recognized that other problems did exist with the system at the time of termination. However, all of these were investigated and found to be of a software bug nature and readily corrected in the short term.

The problems which were encountered during the project development will be considered in four major categories:

(1) Project organization
(2) System engineering
(3) System and software design
(4) System complexity

Each of the problem areas will be discussed in the remainder of this Section.

6.1 Project Organization

Although the organization of the project initially met the apparent needs of all parties concerned, it ultimately resulted in a situation which did not best serve the interests of BC Rail's requirements. The major problems with the organization were:

(1) Preceding system design was compromised in an attempt to create a DCP product capable of operating on a standalone basis free of the Host computer. This resulted firstly in two attempts to design and build a special purpose processor to serve the DCP functions. Secondly, functions originally designed as Host-resident were moved to the DCP. When the processor designs failed and standard off-the-shelf equipment was purchased, choice was limited to software compatible systems. The system was further compromised by not fully redesigning the DCP software to incorporate the additional functions. The cumbersome software development tools consistently compromised the functional capability of the DCP in its expanded role.

(2) Because the system was viewed as three independent products linked by data passed between them, development followed three fairly independent paths: the Host computer, the DCP computer and the ELU and on-board equipment. Until information was needed or problems were discovered no dialogue occurred between the development teams once the communication protocols had been established. This resulted in frustration and poor solutions to problems when one team discovered a problem which affected part of another sub-system which had already been designed or implemented.

(3) Software designs were not checked for compliance with functional intent. By working independently, development teams' interpretations of specifications as the sole source for software design resulted in code which even in the latter stages of the project did not meet the requirements. This resulted

from teams which had no real background in the functional intent of the system further compounded by direction being neither offered nor sought.

(4) The method of memoranda corrections and modification to specification was cumbersome, unwieldly and unreliable. Changes were documented only by memorandum or minutes of meetings and a single change could be covered by the original specification, several memoranda and several minutes of meetings. The final specification was never explicitly re-written to incorporate the change. With the potential ambiguities and misunderstandings introduced by each document, development teams often differed in the functionality of their final implementation.

(5) The desire on the part of team leaders and project management to maintain project schedules probably contributed to many of the above problems. By becoming involved directly in the technical problem solving and implementation, team leaders and project managers alike became introspective. This resulted in a loss of overall project control and a loss of the quality of the work being performed by the various teams. This apparent saving was paid for many times when software failed to meet intent or was difficult to debug and fix.

6.2 System Engineering

From the start of the project two communications related problems were allowed to become entrenched in the system. These problems were further compounded by shifting software functions from the Host to the DCP without a proper analysis of the implications. The problems were:

(1) The communications throughput between the DCP and trains was too low. It was known at the completion of prototype development that the design requirements could not be met with respect to the total number of trains to be handled. Recommendations on improvement at the software level were not acted upon and the resulting lack of throughput directly contributed to termination of the project.

By failing to perform proper system engineering studies to seek a viable solution, known, severe limitations were entrenched into the system.

(2) It was known that several areas of poor communication existed at the start of the project. Although their severity and implications were not fully appreciated until testing of control functions was well underway, it was assumed that the problem

could be readily eliminated in the later stages of the project. What was not appreciated, however, was that the solution was potentially expensive and compounded by a previously agreed to specification of six sites per subdivision in the DCP.

6.3 System and Software Design

On several occasions requests for modification to original system parameters were withdrawn when the magnitude of the changes became known.

Software was designed and implemented using initial parameters. Upward changes to these parameters could only be implemented at a cost of 6-8 weeks required to recompile the DCP software. In some cases program changes were required. A combination of an extremely cumbersome and laborious software development environment and a team inexperienced in large system development contributed to these problems which included:

(1) The number of LIC equipped units being restricted to a total of 66.

(2) The number of radio sites to communicate with trains being restricted to a total of 6.

The first problem caused inconvenience whilst the second contributed directly to the termination of the project.

Inflexibility in the number of messages and their content in the DCP-ELU communication protocol caused some problems:

(1) The DCP effectively isolated the Host from the trains resulting in situations which could not be resolved by the Host. e.g. engineman acknowledge could not always be detected by the Host system.

(2) The protocol's inability to convey detailed error condition codes caused considerable inconvenience and frustration to the dispatcher who could not readily ascertain the reason for an authority being rejected. Whilst the original intent to screen the detailed error codes from the dispatcher was not unreasonable, it was the cost to provide the detail when the need arose which caused the problems.

In general the DCP software was designed and written tightly around the system parameters with no consideration given to the effects of future changes no matter how minor. This was further exemplified in the track model which would be incapable of handling track configurations which could easily be found in other subdivision or revisions to the existing track structure, such as:

(1) Sections of double track

(2) Control points on main or siding tracks between switches.

6.4 System Complexity

At the conclusion of the prototype project it was believed that all major problems had been solved, that requirements for a production system could be defined and that such a system could be readily implemented. Throughout the project, schedules were repeatedly extended and requirements were modified. What was not appreciated at the outset was that the system was a complex one and that the requirements were still undergoing development. Ultimately this resulted in a development project being controlled with the constraints of a production job.

In particular the difficulties encountered in developing the conflict checking software were far greater than expected. The size of the resulting programs caused implementation problems in both the Host and the DCP computers. The resulting large programs required increases to the memory size of both Host and DCP systems.

Although the BC Rail operation is superficially simple the practical implications of the operating rules combined with possible train movements resulted in a complex software development project. Undoubtedly the difficulties described in the preceding pages directly contributed to the final demise of the project. However, the sheer complexity of the requirements must not be underestimated by those intending to continue with the development of the LIC concept.

6.5 Recommendations

Based upon the preceding analysis of problems which contributed towards the termination of the project several recommendations are made below. Although such points may be easily made in retrospect and appear to be obvious or common sense, it can be all to easy to allow pressures of the moment to distort one's judgement. It is therefore imperative that any further development adopt a set of project control rules and rigorously abide by them.

(1) The system must be engineered and designed to operate as a system - not as a set of interconnected products, each compromising the performance of the others.

(2) The system must be fully engineered before any design is started.

(3) System engineering must not allow any assumption to be carried through, no matter how trivial they may appear.

(4) System engineering must include complete loading analyses to ensure that requirements can be fully met by all components of the system.

(5) All requirements and specifications must be fully documented in a central, maintained document.

(6) All changes to specifications must be fully documented in the central document and all team members furnished with amendments.

(7) Use should be made wherever possible of standard products.

(8) Development personnel should interact at all levels and should be located in a single project office.

(9) All standards must be rigorously enforced.

(10) Software must be modular and flexible up to documented limits.

(11) Jobs should be performed according to job descriptions, e.g. team leaders must always provide leadership and must not be allowed to write in code even though it may appear to help a lagging schedule.

7. SYSTEM RELIABILITY

This section will discuss the hardware components of the LIC System with respect to their reliability and availability.

Although the system never achieved full operational status, all hardware was installed and maintained on an operational basis. Most equipment was installed and used for at least one year prior to termination of the project although some units were operating for part of this period with a key piece of LIC equipment missing.

7.1 Basis for Analysis

Maintenance data collected over the period from 1st April 1983 to 30th March 1984 was analyzed. The following major system components were isolated and their failure rates calculated:

- Host computer system and associated peripherals
- DCP computer system
- Communications equipment including the microwave system, remote site units and radios
- Mobile radios
- Engine logic units
- Digitrac components
- Cab display units

Since not all units were fully equipped for proper LIC operation throughout the entire period under review, the actual unit-operating-months of fully equipped units was calculated. To be considered LIC-operational:

- an engine or RDC required that their radio, ELU, Digitrac system and cab display be fully available at the same time,

- a caboose required its radio, ELU and Digitrac system to be available at the same time.

The unit-operating-months were as follows:

RDC's	60
Engines	231
Cabooses	205
Total	496 unit-months

This total compares with a grand total of 12 x 60 = 720 unit-months if all units for which maintenance data is available had been fully equipped. The actual total does not take into account the time to repair each failure on a unit.

7.2 Host Computer System

During the period in review there were two cases of failure of the on-line Host computer attributable to hardware failure. Both instances were caused by disk drive problems.

During this period both Host processors were in constant use for at least eight hours per day. One was used on-line, the other for system development work. Whenever a problem occurred in the on-line system it was swapped functionally with the second system.

In addition to the two failures a number of preventive maintenance procedures were performed on the disk drives during the period. These necessitated swapping processors when work on the on-line disks was performed.

In total the Host system provided adequate reliability for the system and at no time would neither Host processor have been available. However, the RL02 disk drives appear to be the Host system's weakest component.

7.3 DCP Computer System

There were no failures of the DCP hardware during the review period. Problems which were encountered appeared to be due to:

- the fault detection unit which was removed during the year,
- faulty seating of Proms and boards following software updates.

7.4 Communications

During the review period there were no failures of the microwave system, remote site units or radios at the remote sites.

7.5 Mobile Radios

During the review period 30% of failures to on-board equipment which resulted in a loss of LIC functional capability were attributable to failures of on-board radios. A summary of failure statistics for the radios is presented in Table 7.1.

LOCATION	TOTAL FAILURES	MTBF - WEEKS	MTBF - MILES
RDC's	11	22	12, 200
Engines	27	34	10, 700
Cabooses	19	43	-
Total	57	35	-

TABLE 7.1 FAILURE STATISTICS FOR MOBILE RADIOS

7.6 Engine Logic Units

During the review period 47% of failures to on-board equipment which resulted in a loss of LIC functional capability were attributable to failures of engine logic units. A summary of failure statistics for ELU's is presented in Table 7.2.

LOCATION	TOTAL FAILURES	MTBF - WEEKS	MTBF - MILES
RDC's	12	20	11, 200
Engines	74	12	3, 900
Cabooses	4	205	-
Total	90	22	-

TABLE 7.2 FAILURE STATISTICS FOR ENGINE LOGIC UNITS

7.7 Digitrac System

During the review period 12% of failures to on-board equipment which resulted in a loss of LIC functional capability were attributable to the Digitrac system. All failures were due to failure of the interrogator component of the system. A summary of failure statistics for the interrogators is presented in Table 7.3

LOCATION	TOTAL FAILURES	MTBF - WEEKS	MTBF - MILES
RDC's	5	48	67, 200
Engines	10	92	28, 900
Cabooses	9	91	-
Total	24	83	-

TABLE 7.3 FAILURE STATISTICS FOR DIGITRAC (INTERROGATORS)

7.8 Cab Displays

During the review period 11% of all failures (13% of RDC/Engine failures) which resulted in a loss of LIC functional capability were attributable to cab display failures. A summary of failure statistics for cab displays is presented in Table 7.4.

LOCATION	TOTAL FAILURES	MTBF - WEEKS	MTBF - MILES
RDC's	4	60	33, 600
Engines	17	54	17, 000
Total	21	55	20, 200

TABLE 7.4 FAILURE STATISTICS FOR CAB DISPLAYS

7.9 Summary

Operating experience gained throughout the review period indicates that:

- Central equipment and communications equipment performed satisfactorily and would operate within a fully operational system.

- The Host system could be improved by replacing the RL02 disk drives with the more reliable (Winchester) technology (and appropriate backup media).

- The mobile equipment performance was not satisfactory. In total 192 failures occurred during the review period which resulted in a loss of capability. This would typically have meant that the affected trains would be run under written authorities (in the case of RDC and Engine failures) or that the dispatcher must continually clear blocks to the rear of a train (in the case of caboose failures).

- On average one failure occurred every two days. In general it took several days (at least) to get the affected unit into the maintenance shop. This means that at any time at least 4 or 5 units are in operation but without LIC capability. In actual operation this could result in changes to engine consists or operating trains without full LIC capability.

- Radios and engine logic units appear to be the most failure-prone components, especially those mounted in engines.

- A review and analysis of the radios and engine logic units with respect to their mechanical design and mounting should be performed.

8. CONCLUSIONS

This section will present a number of conclusions of the system development based upon the experience gained and information presented in the preceding Sections. The conclusions are made with respect to the seven objectives outlined in the Executive Summary.

8.1 Equipment Installations

All equipment installation problems were resolved for the various units in use, ie. RDC's, engines and cabooses. However, in actual operation some equipment did not perform with a reliability high enough for normal operations to be able to rely on its availability.

8.2 Train Control

All hardware and software for train control was delivered and installed. Although the operation of the software was successful demonstrated in the performance of a set of acceptance tests, the success was not reflected in actual parallel operation. It appears that acceptance tests based upon specific scenarios may be useful for preliminary testing during system integration. However, the complexity and time duration of real train movements makes very thorough parallel testing mandatory for systems of this nature. Because of the complexity of the testing process the time expended exceeded all previous estimates.

In addition, the communications problems which were identified in the previous report could not be readily corrected because of rigid system implementation. Again the effort required to eliminate poor communication areas was underestimated and attempts at improvement were left until they were essential for continued operation of the system.

8.3 L.I.C. Rules

The complete set of LIC Rules were successfully developed and approved by BC Rail. During the parallel operation and testing the rules were slightly modified. Without extended parallel operation and some stand-alone operation, the rules cannot be considered finalized and must be subject to further changes as needed.

8.4 System Availability

Although the system was accepted as ready and available for parallel operation, the acceptance was premature. Because the system had never been operated on a 24-hour basis prior to the start of parallel testing a number of minor software and operational details had not been tested.

8.5 Parallel Operation

Because of problems in system implementation the parallel operation was aborted and therefore must be considered to have failed. The major operational reasons for the failure were that communications with the trains was too slow and that the maximum number of trains which could be handled was too small. Both problems resulted in the dispatcher spending too much time attempting to control the trains.

8.6 Stand-alone Operation

The use of the system for stand-alone operation was not attempted.

8.7 Summary

Although the project cannot be considered to have been brought to a successful conclusion, two positive conclusions should be drawn:

- The project has demonstrated the feasibility of a fully operational radio-based train control system. The problems have been identified and can, with further development, be rectified.

- The experience gained by the development team is invaluable and must be employed to the fullest in any future development.

9. RECOMMENDATIONS

On the basis of the information presented in the preceding Sections and the conclusions drawn from it, a number of specific recommendations are made for the future:

1. Funding should be provided to make the LIC system operational by correcting the deficiencies found in the existing system. The investment of effort by members of the development team as well as the financial support of the project over the last four years are far too great to allow development to stop.

2. Development of LIC into an operational system should commence as soon as possible. Without the experience and expertise of members of the development team any future work risks repetition of problems or creation of new ones. This experience must be put to use quickly before it is lost to time or dispersal of staff.

3. Further development of the LIC concept should:

    - evaluate currently available hardware and technology for use in the system,
    - ensure that complete and rigorous system engineering is performed,
    - ensure that complete communications coverage of all track in the subdivision can be provided,
    - restore the DCP function to that of a communications interface,
    - examine the reliability problems of on-board equipment,
    - ensure that the project is managed and organized in accordance with the detailed recommendations made in Section 6.5,
    - ensure compatibility with the R.A.C./A.A.R. endorsed advanced train control project.

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GLOSSARY

ACKNOWLEDGE BUTTON

A push button device which interacts with the cab display unit and is activated by the engineman to notify the train subsystem he/she concurs with, or is complying with instructions as deemed necessary (Section 2.4).

BAUD

A unit of signalling speed: Baud rate is the number of discrete signal conditions occurring per second.

BLOCK

A uniquely defined and identified length of track in LIC territory; may be one of the following types: main track, siding, additional trackage, or switching zone.

CAB DISPLAY UNIT

An alphanumeric display in the locomotive cab which indicates train speed, location (mileage), and movement authority information. (Section 2.4).

COLOUR GRAPHICS DISPLAY

Three coloured CRT's mounted above the dispatcher's work desk which shows a scaled representation of the LIC territory and all train activities therein. (Section 2.2.4).

COMMUNICATIONS COVERAGE

The combination of a U.H.F. system and microwave system which provides trackside coverage and the data link between the central control subsystem and train subsystems within LIC territory.

CONFLICT CONTROL

The train control software within the central control subsystem which provides the safety checks on train control data generated by the train dispatcher. (Section 5).

CONTROL POINT

A uniquely identified location which defines a boundary of a block of train in LIC territory. (Section 4).

CURSOR

The indicator on a video display terminal screen of the position at which the next character typed will appear -- often appears as a blinking underline character. Cursor control keys (or arrow keys on the VT-100 terminal) allow the user to change the position of the cursor without entering data.

DATA COLLECTION PROCESSOR

A front end computer in the central control subsystem used for data gathering and polling the trains in LIC territory. (Section 3).

DIGITRAC

That part of the LIC train equipment (other than the engine odometer) which is used to establish train location; comprised of transponders, interrogator coil unit, and ICU controller in the engine logic unit. (Section 3).

DISPATCHER DISPLAYS AND REPORTS

A wide range of data displays and reports provided in the central control subsystem to assist the dispatcher in performing his duties, and provide a meaningful management history file. (Section 2.1).

DIRECTIVES

A message to the engineman via the cab display unit directing him/her to carry out some specific action but not granting operating authority.

ENGINE LOGIC UNIT

A zilog Z-80 based microprocessor, which is the heart of the engine and caboose mounted electronic equipment.

FULL CALIBRATION

Automatic calibration of the locomotive odometer which includes the measurement and application of a factor to correct for actual wheel diameter. (Section 1.1).

HOST

The primary computer in the central control subsystem used for all data processing, display, and control execution functions.

INTERROGATOR

The electronics device mounted on a unit for the purpose of reading a transponder number; one of the major components of Digitrac.

LIC OPERATING RULES

A special set of Operating Rules specifically designed for LIC operation.

MENU

A means of human-computer interaction in which the user is presented with a display listing a number of choices from which the desired activity can be selected; the choice is indicated by entering a number, positioning the cursor, or similar means.

MODEM

Short for modulator-demodulator -- a device which converts a serial bit stream into a form which can be transmitted by radio or telephone.

OPERATING AUTHORITIES

A train control command issued by the train dispatcher either by cab display or in written form, authorizing train movement within LIC territory. (Section 2.4.2).

PARALLEL OPERATION

The operation of the LIC System in parallel with the manual train order system to establish system acceptability.

PARITY

A parity bit is a single bit (1 or 0) appended to a word or other unit of digital data in order to make the total number of 1 bits in every such unit either even or odd; the choice of even or odd parity is part of the definition of the communications protocol in effect. Parity checking permits detection of errors in single bits or odd numbers of bits in a message.

PROVISIONAL TRAIN

Every train which enters the LIC System will speak up at the first transponder it encounters; any unit which does so and which is not already associated with a dispatcher-created train sheet will be designated a provisional train.

REMOTE SITE UNIT

A component of the LIC communications subsystem at each remote microwave/radio repeater site; interface between the microwave channel and the UHF train radio.

SIMPLE CALIBRATION

Automatic calibration of the locomotive odometer in which the DCP informs the engine logic unit of the number and exact location of a suitable upcoming transponder; upon detecting the transponder the ELU sets it odometer to the mileage given.

SPEAK-UP

Procedure by which a LIC-equipped train makes its existence known to the central computer.

STAND-ALONE OPERATION

The demonstration of an operational LIC System without the support of the manual train order system.

STRAIGHT THROUGH CONTROL

A modified version of the central control software, which allowed the train control data generated by the train dispatcher to be forwarded without safety checks.

SUPPLY

A record of the engines, caboose, crew and similar data which define the physical make-up of a train; this information is transmitted to the dispatcher prior to the train's departure and is recorded as part of the train sheet.

TRACKING

The process by which the LIC central computer maintains a record of the identify and current location of equipped units within its territory.

TRACK MODEL

One or more computer data files which define the trackage in LIC territory in terms of control point location, grades, track speeds, and other factors.

TRAIN

A collection of one or more units associated with a single LIC train sheet.

TRAIN SHEET

Under LIC operation, a train sheet is the computer's record of all information related to a single train.

TRANSPONDER

A passive electronic device fastened to the roadbed in a location precisely known the the LIC central computer; when energized by a passing LIC vehicle, it transmits a unique identifier.

UNIT

A uniquely identified rail vehicle of one of the following types: engine, RDC (Budd Car), caboose, or other.

WHEEL WEAR FACTOR

A factor app lied by the ELU to locomotive odometer readings to correct for the difference between nominal and actual engine wheel size.

WRITTEN AUTHORITY

Part of LIC Train Control which is used to convey authority to a train or Maintenance-of-Way crew to move on or occupy a specific portion of track.

ABBREVIATIONS

BCH

Bose-Chaudhuri-Hocquengham (code) -- A sequence of bits appended to a digital message prior to transmission to be used by the receiver to detect transmission errors (a generalization of the Hamming codes).

C/S

Continuous Service

CCS

Central Computer Subsystem

CDU

Cab Display Unit

CP

Control Point

CSS

Communications Subsystem

CRT

Cathode Ray Tube -- a name applied to the screen of a video display or monitor.

DCP

Data Collection Processor

DPSK

Differential Phase-Shift Keying -- a means of serial data transmission in which the phase of the transmitted signal is changed according to the logic levels (1 to 0) of the current and previous bits.

ELU

Engine Logic Unit

FSK

Frequency Shift Keying -- Mode of serial data transmission in which a change of logic level is represented by a change in signal frequency.

GF-30

General Motors Diesel Locomotives, 3000 horsepower

HOST

(Not really an abbreviation; the main (mini-computer) component of CCS). (Section 2.1.1)

ICU

Interrogator Coil Unit (Section 2.1.2)

LIC

Location, Identification and Control

OS

Train Report -- traditional railroad term for a report to the dispatcher of the arrival, departure, or passage of a train.

RDC

Rail Diesel Car -- self-propelled passenger rail vehicle; also known as a Budd Car.

RS-232-C

An electrical standard for the interconnection of digital equipment using serial data transmission.

RS-30

Road Switcher Diesel Locomotives, 3000 horsepower

RSU

Remote Site Unit (Section 2.1.3)

TDC

Transport Canada, Research and Development Centre - Ottawa

TSS

Train subsystem

UHF

Ultra-High Frequency -- radio frequencies between 300 MHz (Megahertz, or million cycles per second) and 3000 MHz; the LIC train radios operate in the 450 MHz band.

APPENDIX A

LOCATION, IDENTIFICATION AND CONTROL SYSTEM

FUNCTIONAL OVERVIEW

BC RAIL

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BC RAIL

1.0 INTRODUCTION

The Location, Identification and Control (LIC) System is a computer based traffic management system.

Digital processing equipment is used on board the locomotive, in the caboose, and at the dispatch office. The engineman is provided with a plain-language display unit upon which his operating authority appears. Verification that the train has cleared a block is provided by equipment on the caboose. The dispatcher has a colour video track diagram display showing train location to within a 1/4 mile resolution, and highlighting other track usage and conditions relevant to train movements.

Operations in LIC Territory are governed by the LIC Operating Rules. Highly secure radio communication transactions convey information between the train and the dispatch office. The engineman's information is updated automatically but he must acknowledge certain directives. The acknowledge procedure is also used to convey agreement with changes in operating authorities which are required by the dispatcher.

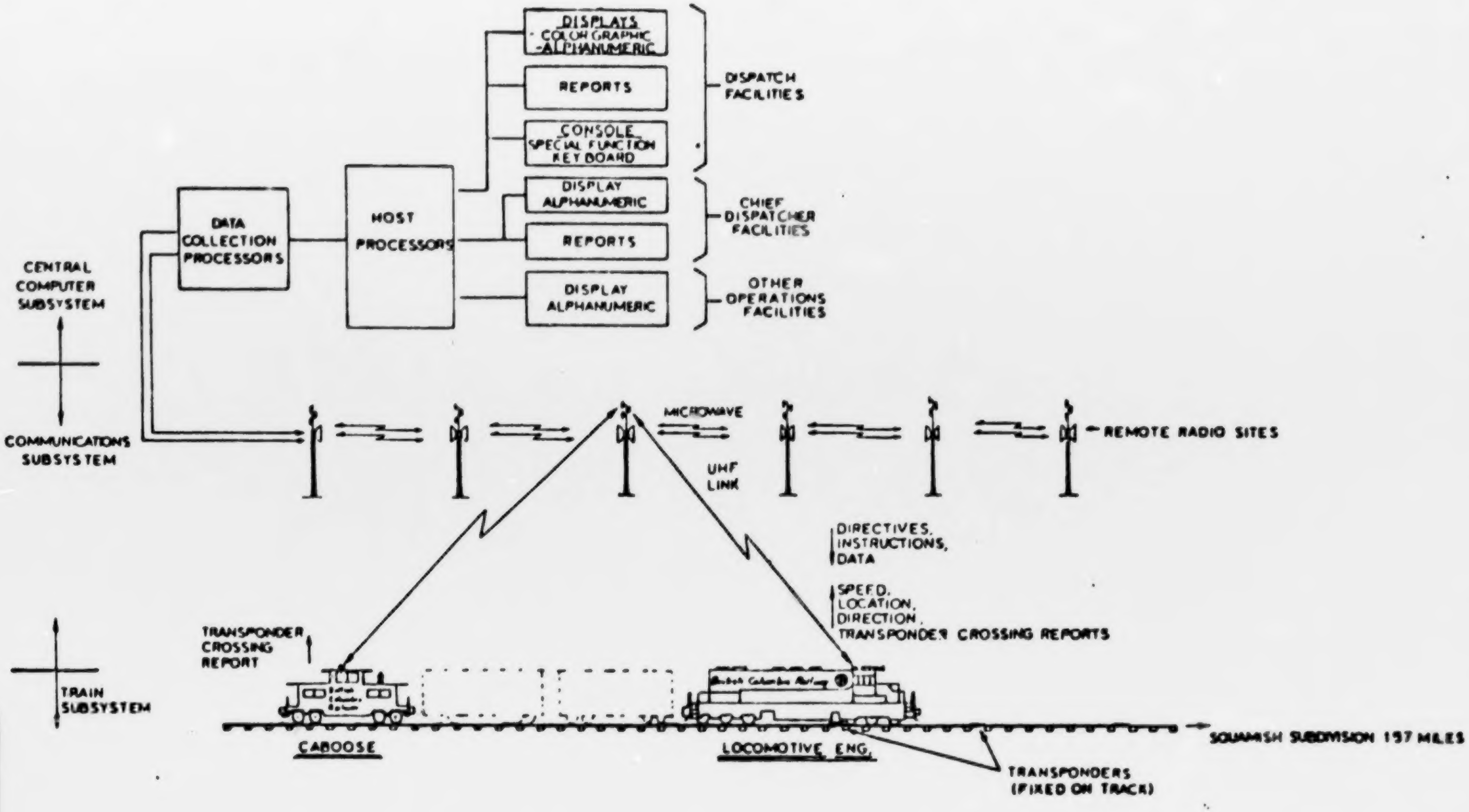
The System is intended to replace train order or manual block control when the level of traffic exceeds the capacity of these systems. It also may be used to augment conventional centralized traffic control by virtue of its detailed speed and location information.

1.1 Description 1979-1984 LIC System

A diagram of the LIC System is shown in Figure A-1. It shows digital radio communication between the central dispatch facility and both ends of the trains operating on the main track of the railroad. Trains transmit their vital information, including identification, location, speed and additional supplementary status information. The central dispatch facility transmits operating instructions to each train.

1.2 Communications System

The communications link between central and each train is a vital element of the system. High security is achieved in the block-organized polling-response system by the use of cyclic redundancy codes, and by the adoption of an enable-check-execute sequence on all vital transactions. BCH Coding provides the required security at the signal-noise ratios encountered. All movement authorities and all reports of entry into and exit from a control block requires a confirmation message from receiver to sender before the sender can conclude that his message has been received correctly. The added security provided by this confirmation sequence virtually eliminates the possibility of an error in the


DISPLAYS COLOR GRAPHIC ALPHANUMERIC
REPORTS
CONSOLE SPECIAL FUNCTION KEY BOARD
DISPATCH FACILITIES
DISPLAY ALPHANUMERIC
REPORTS
CHIEF DISPATCHER FACILITIES
DISPLAY ALPHANUMERIC
OTHER OPERATIONS FACILITIES
DATA COLLECTION PROCESSORS
HOST PROCESSORS
CENTRAL COMPUTER SUBSYSTEM
COMMUNICATIONS SUBSYSTEM
MICROWAVE
UHF LINK
REMOTE RADIO SITES
DIRECTIVES, INSTRUCTIONS, DATA
SPEED, LOCATION, DIRECTION, TRANSPONDER CROSSING REPORTS
TRANSPONDER CROSSING REPORT
TRAIN SUBSYSTEM
CABOOSE
LOCOMOTIVE ENG.
SQUAMISH SUBDIVISION 157 MILES
TRANSPONDERS (FIXED ON TRACK)

BLOCK DIAGRAM OF LIC SYSTEM

FIGURE A-1

communications link.

For reliability, the entire communications link (radios, remote site unit and microwave channel) are duplicated. The computer selects the links alternately on each successive polling cycle to ensure that both links are operating. Should one link fail, the alternating procedure is suspended and a warning message is generated. When the system is informed that the failed link is restored then the alternating scheme is resumed.

1.3 Trackside Equipment

Transponders, each with a unique identifying code, are mounted on the roadbed between the rails. A typical installation around a switch is shown in Figure A-3. Other locations for transponders include the main track when the distance between sidings is great, and at entry/exit points from the main track. Transponders are used to establish control points and the intervening blocks. The geometry of control points at a switch and on main track are shown on Figures A-2 and A-3 respectively. The control points are basic steps of operating authority and no train may cross a control point without authority in the form of either cab display or written instruction.

Each unique transponder number, when picked up by the Interrogator on board a locomotive or caboose and reported to the central computer, serves a location fix. The fix is used to:

a) Calibrate the locomotive odometer derived from an axle generator.

b) Confirm passage of the locomotive over a control point into the next block.

c) Confirm passage of the caboose over a control point and clear of a block.

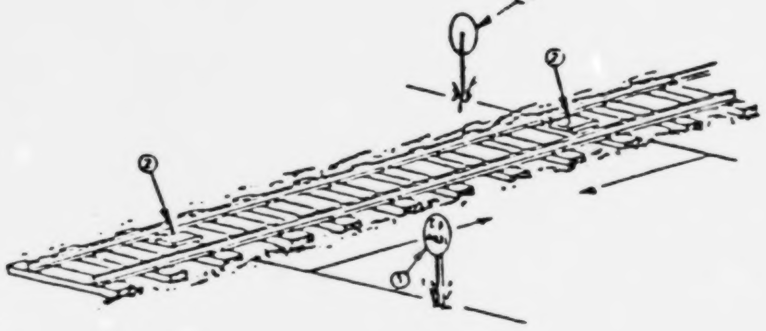
d) Confirm the route taken through a switch.

1.4 Train Equipment

The train equipment includes an Engine Logic Unit (ELU) and Cab Display Unit (CDU) in the lead locomotive. These provide the engineman with plain-language alphanumeric display of important operating data comprising:

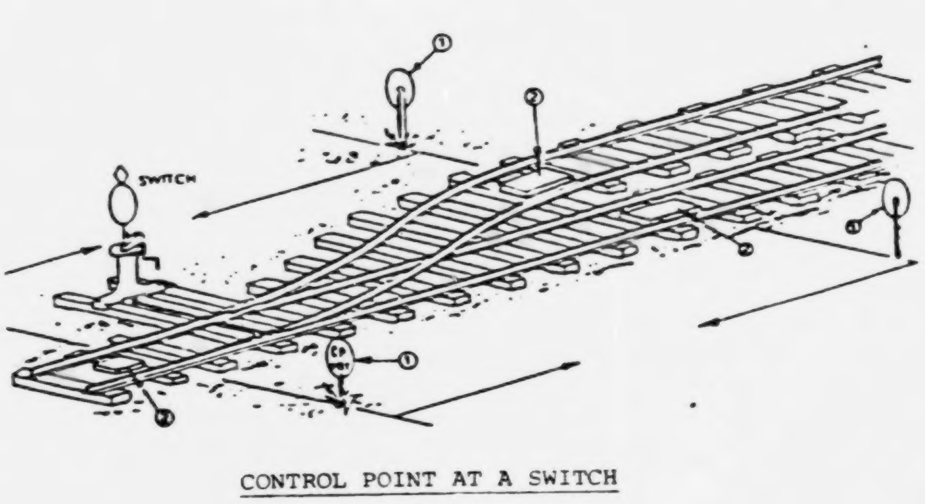
a) Speed

b) Location



CONTROL POINT ON MAIN TRACK

FIGURE A-2


①
②
SWITCH
①
②
①
②

CONTROL POINT AT A SWITCH

FIGURE A-3

c) Control Point Instruction

d) Directives

This information is continually updated and monitored, partly by processing done on board the locomotive and partly through message exchanged with central.

The speed indication and the odometer are computed from the output of an axle generator on the locomotive. They are updated every half second and displayed digitally. The speed indication is displayed continuously but the odometer must be initialized and calibrated by messages from central. The precise location of the next transponder is crossed, the odometer is initialized. The accuracy of the odometer is continuously monitored and is maintained correct within the precision (0.1 mile) on the display indication. Re-calibration occurs automatically and is transparent to the train crew.

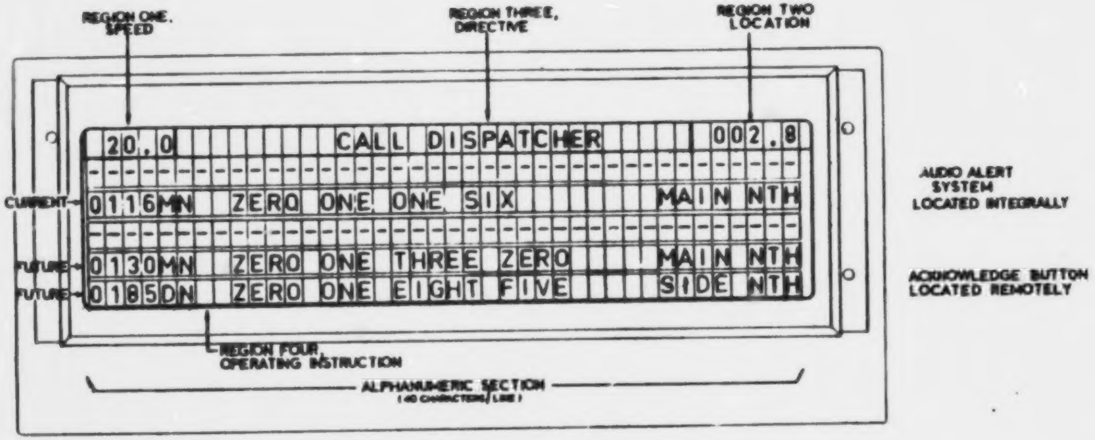
Control Point Instructions give authority for the train crew to proceed as indicated. For main track movements, instructions appear on the display in the format shown in Figure A-4. The current instruction appears between horizontal dashed lines, with the next instruction below it, and the next after that on the bottom line of the display. Three (3) more instructions may be stored in the computer on board. An instruction is considered executed when both the transponders at a control point are read in the correct sequence. At this time the display rolls up, the current instruction is replaced by the one below and instruction moves up one line, and a stored instruction from the on board computer appears on the bottom line. If no more instructions have been issued then a blank line will appear at the bottom of the display. This gives advanced notice to the engineman that the train must be stopped ahead, and states the last control point which can be crossed. When all authorities are executed then a directive to stop before the next control point is displayed for the engineman. Control point numbering corresponds with the subdivision mileage to the nearest tenth.

Authority for switching moves and for proceeding at restricted speed are also issued using prescribed formats on the cab display.

1.5 Central Dispatch Office Equipment

The Central Dispatch Office Equipment consists of a PDP 11/44 Host computer, a Data Collection Processor (DCP), three (3) colour video display units, plus video terminals and printers required for dispatcher interaction. Figure A-5 shows a block diagram of the equipment.

The DCP is linked to the communications network, and handles transactions with the locomotives and cabooses, collects and maintains a data base,


REGION ONE, SPEED
REGION THREE, DIRECTIVE
REGION TWO LOCATION
20.0
CALL DISPATCHER
002.8
CURRENT
0116MN ZERO ONE ONE SIX MAIN NTH
FUTURE
0130MN ZERO ONE THREE ZERO MAIN NTH
FUTURE
0185DN ZERO ONE EIGHT FIVE SIDE NTH
REGION FOUR, OPERATING INSTRUCTION
ALPHANUMERIC SECTION
(40 CHARACTERS/LINE)
AUDIO ALERT SYSTEM LOCATED INTEGRALLY
ACKNOWLEDGE BUTTON LOCATED REMOTELY

LOCOMOTIVE CAB DISPLAY FORMAT

FIGURE A-4

maintains odometer calibration, passes messages from the Host to the locomotive equipment for display, and maintains vigilance for speak-up messages which are sent by any locomotive which illegally crosses a transponder.

The DCP is a microcomputer unit which serves to relieve the Host the task of polling and data collection. It also has the capability to operate in a "stand-alone" configuration without the Host. In this configuration it tracks trains and produces a train graph, but has only limited interactive capability with the dispatcher.

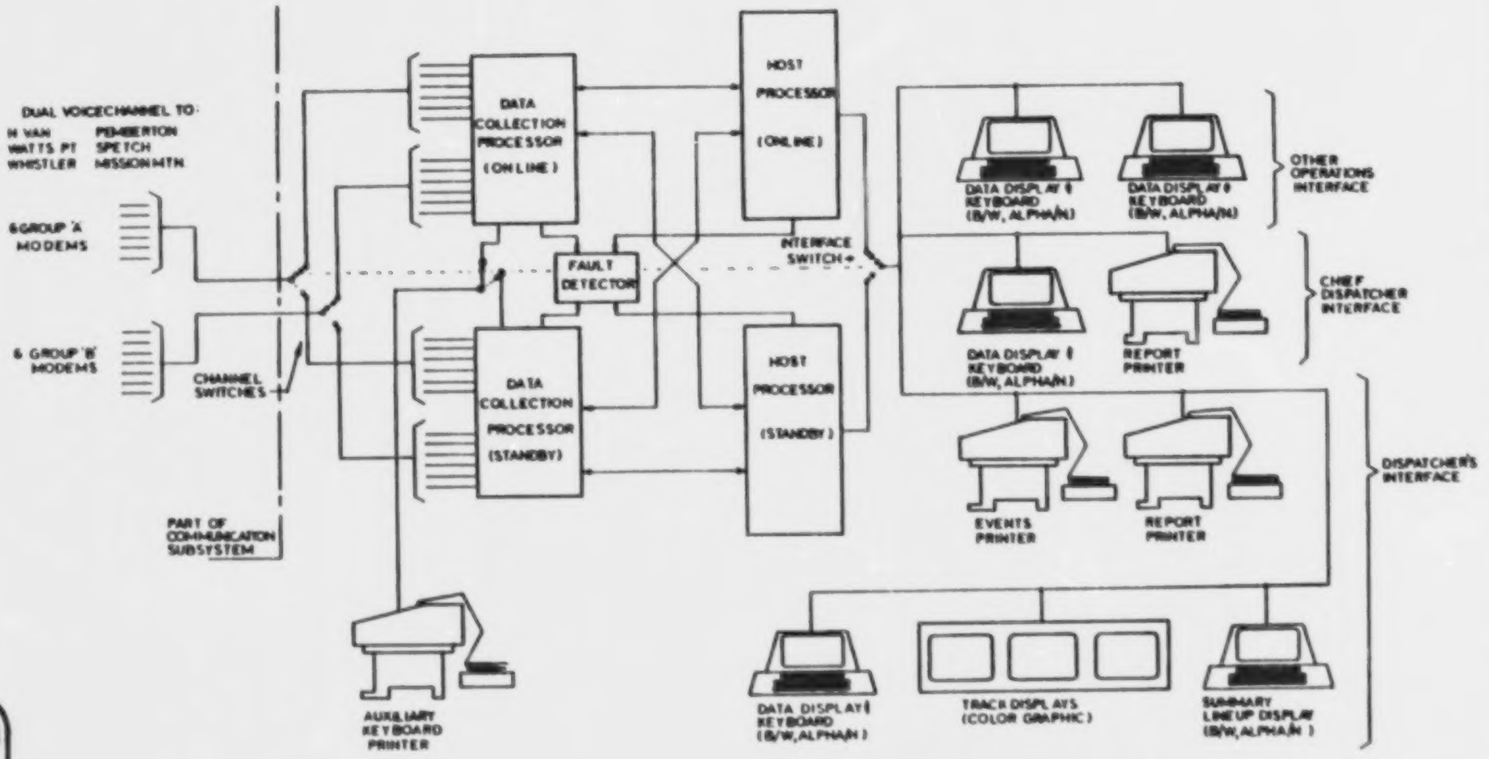
The Host computer, as shown in Figure A-5, requests data from the DCP when required and maintains its own data base. It has interactive devices, displays and report printers connected to it. The major input/output capabilities of the Host include display of the track diagram and track positions on three-colour video display units.

Three display units, mounted side-by-side, show the entire Squamish Subdivision. Colour conventions show track usage according to the type of authority issued. The trains are shown to a precision of 1/4 mile using an arrowhead and train identifier.

The interactive alphanumeric video terminals are used for entry of data by the dispatcher and for the display of working information. The Host computer maintains a computerized train sheet on all trains. Supply data for the train sheet is entered by the dispatcher when the train is called. The complete record of a trip is maintained in the computer, printed on demand, and is stored on magnetic tape when the trip is complete.

The Host computer tracks each train and shows its updated location on the track diagram. It also handles the traffic managements logic whereby trains are given operating authority. It is the dispatcher's responsibility to maintain safety in the instructions which he issues, but the computer completely checks every instruction and maintains records of which sections of track are occupied and which are free. Control point instructions given to a train prevent any other user from obtaining authority for those blocks of track until each is released to other users when the caboose crossed both transponders of the control point.

Many techniques are used within the central dispatch hardware to ensure system integrity. These include software diversity, enable-check-sequences for vital actions, mutual data base checking by the DCP and Host, range, reasonableness and sequence tests on all data and hardware performance monitoring.


DUAL VOICECHANNEL TO:
H VAN
WATTS PT
WHISTLER
PEMBERTON
SPETCH
MISSION MTN
6 GROUP 'A' MODEMS
6 GROUP 'B' MODEMS
CHANNEL SWITCHES
PART OF COMMUNICATION SUBSYSTEM
DATA COLLECTION PROCESSOR (ON LINE)
DATA COLLECTION PROCESSOR (STANDBY)
FAULT DETECTOR
HOST PROCESSOR (ONLINE)
HOST PROCESSOR (STANDBY)
INTERFACE SWITCH
AUXILIARY KEYBOARD PRINTER
DATA DISPLAY & KEYBOARD (B/W, ALPHA/N)
DATA DISPLAY & KEYBOARD (B/W, ALPHA/N)
OTHER OPERATIONS INTERFACE
DATA DISPLAY & KEYBOARD (B/W, ALPHA/N)
REPORT PRINTER
CHIEF DISPATCHER INTERFACE
EVENTS PRINTER
REPORT PRINTER
DATA DISPLAY & KEYBOARD (B/W, ALPHA/N)
TRACK DISPLAYS (COLOR GRAPHIC)
SUMMARY LINEUP DISPLAY (B/W, ALPHA/N)
DISPATCHER'S INTERFACE

CENTRAL COMPUTER SUBSYSTEM

FIGURE A-5

To provide maximum availability of the system, hot standby equipment is incorporated into the dispatch office hardware configuration. The online and standby equipment are interconnected through a fault indicator panel. The panel permits manual selection of which equipment is on line, and monitors each DCP and Host computer for status and failure indications. Should a failure occur, the system automatically switches over to the standby equipment.

1.6 Dispatcher Operation

Railway operation under the LIC System will bring about marked technological changes. The work of the Train Dispatcher who plans and is responsible for controlling train movements will be lessened and simplified.

Specific benefits brought by the system to a dispatcher's job may be summed up in the following areas:

a) Ready access to visual graphics containing current and updated information of train location.

b) Paper work is minimized as train sheet and other records become readily available through computer print terminal.

c) Prompt and easier method of issuing instructions to trains.

d) Uninterrupted time to plan ahead and review intended train movements.

e) Continuous calculation and display of engine speed.

f) Use of digital computers to collect, analyze and store reported data.

The dispatcher issues all operating authorities and work permits in terms of control points. A train proceeding enroute will receive a set of authorities called Control Point Instructions, permitting it to cross each control point transponder in sequence. Similarly, work and maintenance-of-way instructions are defined between designated control points.

Control Point Instructions are generated by the computer, but are requested and released manually by the dispatcher. In the lead locomotive, the three most immediate instructions appear in a column on the cab display in top-down order of execution. Up to three further instructions may be stored but not displayed. When a control point is crossed, the display "rolls-up", the instruction moves up one place on the display. If an instruction is stored, it will now appear at the bottom of the column. The engineman may only cross control points for which an instruction is displayed. Should all displayed instructions be executed or should his instructions disappear, the train must be stopped.

The caboose-installed equipment provides positive information when the end of the train crosses each control point. This clears the occupancy of the block and permits following movements to receive further operating authority.

1.7 The Train Crews' Role in the LIC System

Despite technological changes with the computer-oriented system introduced aboard the trains, without the engineman and the train crews to execute operating authority, the system means nothing. Conversely, the engineman is the last component on the intricate system for whom visual orders and instructions are intended. The physical responsibility of moving the train from point A to point B still belongs to the engineman.

The LIC System has made the engineman's job easier than the conventional train order system by displaying restrictions one at a time in order they are required to be executed. Along with this information, the engineman has current speed displayed to the nearest tenth of a mile per hour and odometer readings which corresponds with the subdivision mileage.

Specific benefits brought by the system which assist the train crews may be summed up as follows:

- Train orders are eliminated, less paper work to contend with.
- Unplanned events are more easily handled such as changing meets.
- Positive protection is provided to the rear of a train.
- Unauthorized entry into a controlled block by an engine generates a warning on board the locomotive and also in the dispatcher's office.

APPENDIX B

BC RAIL
LOCATION, IDENTIFICATION AND CONTROL SYSTEM
ACCEPTANCE TEST PLAN

ISSUE 3 - 13 MAY 1982

BC RAIL

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1. SCOPE

This document describes the overall approach which will be taken to acceptance testing the production LIC System. The document does not specify detailed test procedures but rather defines the plan of tests which will be adopted to formally acceptance test the system.

2. APPLICABLE DOCUMENTS

2.1 Functional specifications of the Location Identification and Control System. Volumes 1 and 2, April 1980 prepared by Datap Systems.

2.2 LIC System Train Subsystem Specification, GL2025-002.

2.3 LIC System DCP/ELU Communications Protocol & Message Catalogue, GL2025-005.

2.4 LIC System Host/DCP Communications Protocol & Message Catalogue, GL3738-001.

2.5 LIC System Data Collection Processor Software Specification, GL3488-001.

2.6 Data Collection Processor Hardware Specification, GL6780-001.

2.7 Host System Software Specification, Datap #6015-101-11.

2.8 Schedule 'A', Statement of Work, British Columbia Railways Contract with 'Her Majesty the Queen' as defined by SN 0ST78-00217.

2.9 LIC System Host Computer Software Proposal, LIC-P94.

2.10 LIC System Project Memo file.

3. TEST REQUIREMENT

The objective of this test plan is to provide a means whereby the performance of the LIC System can be demonstrated as having met the requirements of the functional specification.

The specific requirement for testing is that system acceptance testing will be performed jointly by BC Rail, Glenayre and Datap to ensure and document compliance with the Specifications.

The schedule of tests has been planned to follow a progressive sequence of function testing and integration, with the final stage being a full system functional test.

For hardware units, the functions will be tested on an individual basis, prior to integration into the System. This testing falls beyond the scope of acceptance testing, but is mentioned for completeness. An outline of the approach to unit testing is given in Appendix A1.

The individual units will be integrated such that the functioning of the System is built up in an orderly and logical manner. This approach will ensure only one new item or functional change is incorporated and tested at one time. Where operation requires using two untested units or functions, then the operation of one of these may be simulated using special purpose software. The use of these simulators is especially justified in testing the interaction of two systems, such as the DCP and TSS or the Host and DCP. In these cases, the use of simulation software is invaluable in establishing the base rules for the communications link.

When integration has proceeded to the point where the full system has been achieved, a full system test will be performed against the System specification.

The field tests will be a logical extension to the previous tests and will follow the same pattern of function testing and integration. These tests will be specifically planned to evaluate the tracking and train control performance over an extended period and to compare the results with those previously obtained. Initially, the System will be equipped with a single Host/DCP pair which will be used to track and control the 13 LIC equipped trains. The same tests will be repeated at a later stage with a fully equipped system. These tests will also be scheduled to check the standby DCP/Host's ability to assume control of the System in the event of a fault in the on-line system.

For the successful completion of acceptance tests, the following criteria must be met by BC Rail:

a) The communications system will be available and features will be as detailed in the BC Rail communications subsystem document dated 25 February, 1980.

b) The fault indicator shall be demonstrated as meeting the requirements of the Host software specification section 8.6.

It is proposed that for the duration of testing, a complete record of the systems performance be kept. The specific requirements for this documentation are given in section 11 of this document.

It should be noted it will be BC Rail's responsibility to witness and keep a record of acceptance of each phase of testing.

4. TEST PHASES

Six test phases have been defined which will specifically meet the requirements for acceptance testing of the LIC System. For each phase the overall test criteria are given, followed by a list of items or functions to be tested. Where necessary, the criteria for judging the success or failure of specific function tests are defined.

An overview of the test plan is given in Appendix A2. This contains a summary of the test phases, scheduled date and the responsibility for performing and evaluating the tests. The criteria which determine the responsibility during acceptance testing are given below:

a) Glenayre: Test of the production DCP and train subsystem equipment to demonstrate conformance with the Specification. Furthermore, to confirm the operation of the equipment when operating as part of a LIC System.

b) Datap: Test of the Host system hardware and software to ensure compliance with the Specification and confirm the compatibility of the Host when operating with DCPs in a LIC System.

c) Glenayre, Datap, BC Rail: Field testing will confirm the compliance of overall system performance with the LIC System functional specifications.

These tests are also planned to fulfill in part the requirements of Schedule A of the BC Rail Work Statement.

5. PHASE 1

The objectives are firstly to provide a means of proving the performance of the train subsystem by conducting a subsystem test against the specification. Secondly, to verify the performance of the DCPs as a stand-alone tracking system and a front end processor for the Host system.

The overall schedule of tests will prove as much of the System as possible within the constraints imposed by using simulated field data. However, the component units and functions will be verified, and the overall compatibility of the Glenayre equipment demonstrated.

The tests will be carried out by Glenayre at their plant.

5.1 Train Subsystem

The train subsystem is responsible for providing location, identification, speed and status information from the train to the data collection processors. It will also provide the engineman with a display of movement authority, speed and location information in a safe manner.

The System will be tested to ensure it performs the above mentioned functions in accordance with the system specification GL 2025-002.

The tests will be conducted using the ELU performance monitor facility to provide access to the internal status of the System.

The specific functions of the System which will be verified are as follows:

5.1.1 Digitrac system:

- a) Transponder detection
- b) Noise and error rejection

5.1.2 Engine logic unit identification and configuration.

5.1.3 ELU status functions and flags.

5.1.4 Axle generator input, speed, location and calibration functions.

5.1.5 Forward and reverse sense interface.

5.1.6 Transponder and control point instruction buffers.

5.1.7 Cab display interface, protocol and format.

5.1.8 Cab display safety processing.

5.1.9 Communications interface, modem, TX ON and safety timer.

5.1.10 Watchdog timer and fault detection.

5.1.11 Forced fail and fuse blowing circuitry.

5.1.12 Acknowledge push button interface.

5.1.13 ELU system disable by MU/2 valve for trailing loco operation.

5.2 DCP/ELU Communications Protocol

The protocol defines the message format and content for all data transfers between the data collection processors and the train subsystem.

The interface will be demonstrated as performing to the DCP/ELU Communications Protocol and Message Catalogue Specification GL 2025-005.

At this stage, the DCP functions will be emulated by ELU hardware running under the control of DCP simulation software.

The following basic features of the protocol will be verified:

5.2.1 Message preamble, switchover and leader transmission times.

5.2.2 Block structure, block zero structure:

a) Logic unit function
b) Logic unit ID
c) Message type

5.2.3 Message exchange, ELU initialization via speak up.

5.2.4 Message recognition, by unit ID.

5.2.5 Message category identification:

a) Status requests and reports
b) Status report and echo report change
c) Directive, echo directive and directive execute

5.2.6 Verification of message catalogue:

a) Messages and responses
b) Message transactions
c) Message sequences

5.2.7 Syntax error recognition and reporting.

5.2.8 Context error recognition and reporting.

5.2.9 BCH error and transmission errors.

5.3 DCP System Test

The objective of the System Test is to prove the performance of the DCPs when acting as a basic tracking processor and a front end processor to the Host computer. Furthermore, the tests will prove the compatibility and performance of the Glenayre equipment before integration with the field equipment.

The tests will cover all sections of the DCP Software Specification GL 3488-001 that can be verified without access to the field equipment.

Those features of the DCP that rely on the Host processors will be tested using a Host simulator to emulate the functions the Host would normally perform.

The test procedure will ensure the DCP meets the following criteria:

5.3.1 Operator Interface

The DCP operator console entered commands and requests will be confirmed against section 3.10.2 of the DCP software specification.

5.3.2 Train Tracking Functions

The following functions will be tested using simulated train movement data:

a) Transponder location
b) Odometer, speed and direction detection
c) Train location

The results will be an indication of the performance of the system and will not be statistically evaluated.

5.3.3 DCP/ELU Communications Handling

The DCP's ability to maintain communications with the ELUs, according to the coverage model and channel selection criteria will be tested. The specific areas of test activity will be:

a) Channel controls and switchover

b) Site and channel selection
c) Transaction initiation and handling
d) Speak-ups
e) Fault conditions

5.3.4 DCP Reports

The repertoire of operator initiated and event driven reports will be tested for format and content against those specified in section 3.10.3 of the DCP Software Specification. All DCP reports will be produced on the operator console and preserved with the system test log.

5.3.5 Host/DCP Interface Handling

The interface will be tested with the Host simulator against the communications protocol and message catalogue GL 3738-001. The following basic parameters will be verified:

a) Group and block structure
b) Link initialization
c) Data request, command and data to DCP transactions
d) Message and transaction recognition for on-line DCP and off-line DCP
e) Priority structure
f) Timeout and message re-initialization
g) Context, syntax and BCH error handling

5.3.6 Data Maintenance

It will be verified that the DCP will maintain stored data pertaining to trains which are made known the DCP by the Host. Train list update messages will be sent to the DCP and the following areas of stored data verified against the Specification:

a) Train File Data
b) Train Tracking Data

5.3.7 System Initialization

The startup and initialization procedures will be tested with particular reference to the track model and unit ID list. The procedure for initiating DCPs to the on-line and off-line configuration will be verified.

6. PHASE 2

The objective is, firstly, to verify and debug the DCP tracking and train control software under dynamic conditions at the Glenayre plant. Secondly, to integrate the DCP with the communications system and perform a precise tracking and train control test under field conditions.

The objectives will be met by making two controlled test trips using the LIC equipped Wickham V-10 test vehicle. The Glenayre Host simulator will be used to interface with the DCP and initiate and execute train control functions that would otherwise require the Host processor.

It will be the responsibility of Glenayre to operate the DCP, gather and evaluate all test results and statistics during the two trips and subsequent run up period. BC Rail will operate the V-10 vehicle under the directives given by the test procedure. Glenayre will provide a support engineer on the V-10.

6.1 Phase 2a

The initial trip will be conducted with the DCP simulator or DCP based at the Glenayre plant and linked to the in-house UHF, LIC communications link. The V-10 will be tracked and issued with control instructions for evaluation purposes, over the track from North Vancouver to CP12 and return.

The schedule of tests will verify as many of the DCP functions as possible, specifically the following criteria will be satisfied:

6.1.1 Transponder Reporting

The DCP will track the V10 and report all crossed transponders in accordance with the implemented track plan. Cross correlating data regarding transponder crossings will be taken by staff on the V10. The transponder reporting information will be made available as a hard copy on the DCP events printer. Furthermore, a full record of train location will be kept on a separate printer using the DCP traingraph functions to print the V10s location every five minutes.

6.1.2 Odometer Calibration Tests

The full calibration function will be performed with the DCP in the tracking only mode. The following functions will be verified as specified:

a) Tracking mode

   i) speak up at first transponder

ii) infer direction at second transponder
iii) calibrate odometer at third transponder, at least one mile from second

Odometer Accuracy

Cross reference will be made by recording odometer readings on the V10 cab display at control point crossings and over the measured mile located at mile four.

A full record of speak ups and calibration will be kept on the DCP report printer.

6.1.3 Train Control Functions

A full sequence of train control instructions will be planned to verify the following functions:

a) Cab display authority
b) Cancel cab display authority
c) Acknowledge when ready
d) Call dispatcher
e) Trip initialization sequence
f) Cab display roll up
g) Cab display, manual OS

A full record of the complete sequence of events will be recorded against actual V10 movements and actions.

6.1.4 DCP Reports

The following reports will be verified for format and content:

a) Speaking up
b) Calibration & calibration report
c) Data update report
d) ELU status change
e) Trip summary
f) Transponder report

6.2 Phase 2b

The second phase of testing is a natural progression from the previous tests and relies on the fact that the DCP software will be partially proven.

The trip will be conducted with the DCP simulator or DCP based at the LIC office and configured with the full communications system and host simulator. The V10 will be tracked and issued with control instructions to an operational format, over the track from North Vancouver to Squamish.

The schedule of tests will be based on those of Phase 2a. However, the following criteria will also be met:

6.2.1 Communications System

A list of communication statistics will be compiled for the trip; these will include information given in the following DCP reports:

a) Communications report
b) Statistics summary
c) Communications fail/restore

7. PHASE 3

The objective of this phase is to test that the Host system software meets the requirements imposed by the Specification, prior to its integration with the DCP and field equipment.

The schedule of tests will only verify those functions that may be performed by the Host system in conjunction with its dedicated peripherals. Furthermore the testing will be conducted in three sections, firstly tracking only functions, secondly train control functions and lastly full system dual operation functions. Those functions of the Host system not verified by dynamic testing in the relevant following test phases.

Datap will conduct all test at the LIC office and will demonstrate that the system complies with applicable sections of the LIC system Functional specification, subject to project memo revisions. The tests will be conducted to precede the test phases to which they specifically relate.

All individual tests and results will be recorded by Datap and evaluated by Glenayre at or immediately after the time of testing.

7.1 Tracking Mode Stand-alone Functions

The tests will be conducted and performance demonstrated over a two day period prior to the commencement of phase four testing. The following functions will be evaluated in this section:

7.1.1 Dispatcher Interface

The criteria by which the compliance of the dispatcher interface will be determined are as follows:

a) Graphics track diagram display: For each display unit, the static information representation will be verified against the format defined in the Host software specification. Specifically, the track layout, sidings, control points and location designations will be confirmed against the final implementation of the track model. Furthermore, the display will be checked for colour coding, station names and the fixed display title.

The dynamic display of time and date for each unit will be checked and the synchronism verified.

The overall display on the colour graphics CRT will be viewed and evaluated for continuity, format and representation of the status of LIC track. Video display quality is a BCR responsibility.

b) Train sheet data entry: Data entry for train sheets will be enabled by a defined function key on the dispatchers consoles. The following function groups must be menu selectable:

1. Propose train sheet
2. Update train sheet
3. Update train sheet status

The data entry operation and display format will be verified for each of the possible menu selections from the above group.

c) System reports and logs: Reports and logs will be enabled by function key on the dispatcher console and hence selected by menu from these three categories:

1. train sheet reports - see (b) above
2. logs
3. system reports

The reports will be made available at the displays or as a hard copy at the report printer.

The selection, content and format for each of the possible reports will be verified against the BC Rail display and print out specification.

A hard copy of each report must be made and compiled as a permanent record of format compliance.

7.1.2 Significant Events Reporting

Significant events will be detected by the Host software which will log the events on the dedicated printer. The following reports will be verified at this stage.

a) Activation of trainsheet
b) Entry of data into trainsheets
c) Requests for displays and reports

All report formats will be verified against those defined in the Host system software specification.

7.1.3 Host/DCP Interface

A further test of the Host/DCP interface handling will be conducted as per 5.3.5 of this test plan, except the actual host processor will now be used. The tests will prove all of the given parameters of 5.3.5 and will also establish operating compatibility of the Host and DCP prior to commencing full tracking tests.

7.2 Train Control Mode Stand-alone Functions

The tests will be performed and a single days demonstration given prior to phase five testing.

7.2.1 Special Function Keyboard Functions

It will be verified that the "special function keyboard" will allow the dispatcher to perform the following functions.

a) Issue and cancel cab display authorities
b) Enter and cancel written route authorities
c) Enter and cancel written authorities
d) Issue and cancel directional blocking
e) Create and cancel occupancy
f) Enter manual O.S.'s
g) Issue and cancel directives
h) Manual override
i) Cancel computer protect
j) Force fail

For each specific function in the groups given above, entry keying sequences and display formats will be verified against those given in the special function keyboard specifications.

7.2.2 Graphics Track Diagram Display

It will be demonstrated that the colour graphics display depicts the status of the system, with respect to the following train control functions.

a) Cab display and written route authorities
b) Cab display switching authority
c) Restricted route authority, cab display and written
d) Written authority
e) Directional blocking
f) Switch Alignment
g) Occupancy
h) Computer protect

It will be verified that status of each of the above functions is displayed by the graphics CRT's in the manner stated in the specification. In particular it will be checked that the colour conventions for each function are correct and that only those sections to which the function applies are appropriately coloured. It should be noted that all functions will be unconfirmed by the DCP and will thus be displayed blinking.

7.2.3 Significant Events Reporting

The following categories of reports will be verified within the constraints imposed by operating in the stand-alone mode.

a) System alerts
b) Special function keyboard activity
c) Other user activities

All report formats will be verified against those defined in the Host System software specification.

7.2.4 Manual OS

The function selection will be from a display giving each of the four manual OS operations. The data entry requirements for each operation will be verified against those given in the Host software specification.

7.2.5 Shift Change

The transfer of dispatchers will be performed in four phases, the display and entry requirements for each phase will be verified against those defined in the Host software specification.

7.3 System/Dual Operation Functions

The tests will be conducted over a one day period to demonstrate compliance with the specification. The schedule date will be prior to commencement of phase six testing.

7.3.1 System Procedures

The System will operate with a minimum of manual intervention; however, some system related procedures will have to be performed. The system functions given will be fully verified against the specified procedures:

a) System start up: specifically booting, mode selection, off-line updating and train sheet initialization
b) Processor switchover: fault panel interface and peripheral/communications channel switching
c) Real time clock: interface, accuracy, programming and power fail hold up
d) Data base maintenance: off line editing of track model, communications model and unit data
e) System power fail recovery
f) Abnormal conditions: error conditions will be induced and the system monitored for degradation of safety and performance

7.3.2 Significant Events

It will be verified that the Host logs all of the following system alarms.

a) Power failure
b) Online host failure
c) Offline host failure
d) Host peripheral failure

8. PHASE 4

The objective is to evaluate the full train tracking functions and dispatcher assist features with a single Host DCP configuration. The system will be shown to be capable of tracking up to twenty LIC equipped units or provisional trains on the subdivision at any time.

Performance will be evaluated against previously established standards for an aggregate period of thirty days of error free LIC operation. Error free will be defined as a level of operation whereby the system meets the tracking performance requirements established in the specification. Furthermore operational hours will only be accrued when system availability at the control office is 91% or more and individual vehicles complete at least 96% of a trip error free.

Glenayre and Datap will jointly conduct the tests and provide system support during the evaluation period. BC Rail will ensure traffic levels such that all criteria can be met within the specified period and will furthermore endeavour to operate LIC equipped engines and cabooses as trains. It will be BC Rails responsibility to gather the generated statistics, and to evaluate and document the systems performance.

The given functions will be independently evaluated, failure of any single function will not be taken as a failure of the overall test phase. The following functions will be evaluated against the criteria given:

8.1 Transponder Reporting

The following data will be generated for all LIC transponder crossings:

a) Date and time of day
b) Unit ID
c) Transponder number
d) Location
e) Time of transponder crossing (+or-30s)

BC Rail will transcribe the data into a format compatible to that used for previously obtained results. In addition they will generate separate records of location and vehicle statistics, pertaining to the transponders and equipped vehicles in use at the time.

The reporting criteria will be based on a series of samples of 10000 LIC operational crossing reports, a minimum of four such samples being required to satisfy test requirements. For each sample the number of legitimately missed transponders will be determined. This figure will be used in conjunction with the sample size to verify the mean reporting success is in excess of 99.8%. Furthermore the mean reporting success for all samples will be averaged to prove the overall reporting success is in excess of 99.8%. Any deterioration in reporting between samples will be immediately investigated and such corrective actions as is necessary taken.

In the event that the transponder reporting success is found to be less than 99.8%, then the contribution to this reduction of the Digitrac and communication systems will be separately evaluated.

Furthermore transponder reporting will be compared with the transponder reporting histories obtained from previous tests.

8.2 Odometer Calibration

Statistics will be gathered to verify that the specified calibration procedure is followed for the tracking only mode. The following criteria will be met:

a) Speak up at first detected transponder
b) Infer direction at second transponder
c) Simple calibration at third transponder at least one mile from second
d) Full calibration at next suitable transponder
e) Automatic recalibration on detection of greater than a 0.05 mile error at a transponder
f) Accumulated odometer error will not exceed 0.1 mile

BC Rail will gather the statistics from the DCP report printer and evaluate the results against those previously obtained.

8.3 Communications Coverage

The following communication statistics will be generated for each of the units in service:

a) Total number of transmissions for trip
b) Total number of responses for trip
c) Total number of speak ups for trip

Furthermore, the results will be compiled and evaluated to give location, vehicle and individual site coverage statistics. BC Rail will analyze and compare communications system performance with previously obtained results. Specifically, they will endeavour to pinpoint any areas of poor coverage that could lead to a degradation of system safety. Adequa performance of the communications subsystem is a specific requirement o BC Rail.

8.4 Train Location

Data specifying the location of all units being tracked will be maintained for the duration of testing. The location of units or trains will be given to within 0.5m of the actual location in the following manner:

a) A traingraph will be produced by the DCP, this will provide the Unit ID versus mileage for engines at five minute intervals and at CP crossings for cabooses. The results will be compared with previous results and checked against the transponder reports for accuracy.

This test will be specific responsibility of Glenayre.

b) The host system will provide the location and ID of all LIC engines on a graphics track diagram display. It will be shown that the train representation arrow is located in the same block as the train that it depicts. Also, the scaled distance of the arrow through this block will be compared with the actual distance travelled into the block. The arrow will always show the last known direction of travel.

All possible sections of track will be tested for location, if necessary using the V10 vehicle to perform moves over rarely used trackage.

This test will be the specific responsibility of Datap.

8.5 Dispatcher Assist Functions

The following Host system dispatcher assist features will be operationally evaluated by BC Rail during the test period:

a) Train Sheet Manipulation - train sheets will be generated for all LIC equipped trains operating over the subdivision
b) Reports and Logs - all possible reports and logs will be exercised during the test period
c) Dispatcher Shift Change - the dispatcher transfer function will be verified
d) The graphics display will be evaluated in accordance with the specification for overall operating suitability

BC Rail will fully document and comment on their findings with respect to the dispatcher assist functions.

8.6 System Loading

The system will be demonstrated as meeting the full functional requirements of tracking 13 LIC equipped trains. The loading on the system will be increased by severing and reinstating firstly the communications link and then the DCP and communications link simultaneously.

BC RAIL

9. PHASE 5

The objective of this phase is to demonstrate through sixty days of error free operation that train control subsystem performance meets the requirements given in the specification. The tests will be performed with a single Host-DCP system configuration. For the purpose of this test error free will be defined as "meeting all train control performance requirements established in the specification." The duration of the trials will be an aggregate period of sixty days, accrued operational time will be governed by the same criteria as given in phase 4.

Glenayre, Datap and BC Rail will jointly conduct the tests. BC Rail will be responsible for evaluating and reporting on the results obtained during the test period. Furthermore, BC Rail will supply on-train staff to monitor cab-display and system performance during train control test trips.

The tests will be conducted in obeyance with the LIC system operating rules, which will form a reference for system operation and evaluation.

The effort will be divided into two tasks; firstly to verify the basic system operation and then to utilize train control functions under operational conditions. These two objectives will be met as given below.

a) Initial testing will be conducted using the V10 test vehicle to make controlled test trips from North Vancouver to Lillooet and return under LIC authorities. It will be a specific requirement that all possible routes are traversed under cab-display authorities. Also every opportunity will be taken to attempt to create conflict situations when setting up LIC authorities for the V10. Furthermore, any other LIC equipped train on the subdivision will be treated as operating under written instructions as specified by written route LIC Rule. A full record of authorities issued, cab displays and directives will be kept for each trip made. It is envisaged that the requirements of this task can be met by five return test trips.

b) After successful completion of the first task, designated LIC equipped trains will be monitored under simulated LIC train control operation. Trains will operate to train orders which will also be used to generate equivalent LIC authorities for both equipped and non-equipped trains.

Suitable monitoring facilities will be established on equipped trains (ie; CDU on second engine) which will allow evaluation of cab display authorities and directives. Furthermore, an RDC unit will be equipped with the CDU in the baggage area, to facilitate monitoring of control functions. It will be ensured that this unit is used on the regular

North Vancouver to Lillooet daily return trip.

A full record of all trips made under dual LIC/Train Order control and the corresponding LIC's clearances will be kept.

For the duration of testing, the following criteria will be used to evaluate system operation:

9.1 Train Control Operator Functions

The implemented functions and directives will be verified against the Host software specification and LIC operating rules. The tests will verify entry, checking and implementation for the following function groups:

a) Issue and cancel cab display authorities
b) Enter and cancel written route and occupancy authorities
c) Issue directional blocking
d) Create and cancel occupancy
e) Manual O.S. operations
f) Issue and cancel directives to engineman
g) Cancel computer protect
h) Manual override
i) Force Fail

9.2 Conflict Detection

For each of the functions given in 1, it will be confirmed that the specified conflict detection criteria are met. The system's ability to analyze occupancy and authority data and prevent conflict situations from arising will be verified under all normal and abnormal operating conditions. Furthermore, the system's ability to safely control several trains in complex meet, pass or combination manoeuvres will be verified.

Specifically, it will be ensured that no authority will be created which will endanger the safety of trains complying with LIC operational rules.

9.3 Cab Display

All possible cab display authorities and directives will be generated and verified in accordance with the specification and LIC operating rules. Deliberate attempts will be made to induce displays which could lead to the train being placed in an unsafe condition.

It will be ensured that under no normal or error conditions will the cab display give rise to mis-interpretation of an authority such that the safety of the system could be endangered.

9.4 Graphics Track Diagram Display

All sections of the track diagram display will be verified as showing the correct colour conventions for the type of authority. Furthermore, all authorities, directional blockings and inferred switch alignments will be shown by the specified symbol in the position to which the control function applies. Also, the correct conventions for unconfirmed authorities and operating authority violation will be confirmed. It will be verified that under operational conditions, at no time will the display give rise to a mis-interpretation of authority which could cause a degradation of safety.

9.5 Train Control Function Reporting

It will be confirmed that a record of the following functions is kept on the system events printer:

a) Manual override
b) Issuing cab display and written authorities
c) Issuing directional blocking
d) Manual O.S.
e) Issuing a directive
f) Issuing a siding occupancy
g) Cancelling cab display and written authorities
h) Cancelling directional blocking
i) Cancelling siding occupancy

This hard-copy record will be kept for each of the controlled trips made through the system.

10. PHASE 6

The objective of this phase is to demonstrate the full LIC System implementation as having met the requirements of the functional specification for a period of one month. Furthermore, it will be verified that the system is acceptable for in-service testing in parallel with manual train order control.

While the tests will be conducted jointly by Glenayre, Datap and BC Railway, it will be the latter's responsibility to evaluate and report on the results obtained in the test period. Furthermore, BC Railway will ensure that their operations staff become fully acquainted with the system during this period.

Certain areas of testing will overlap with previous phases, but the various criteria will be reassessed with the full LIC system implementation. It will be a requirement that all hardware is of production type and is fully installed, all software will be of the latest versions and all functions will be fully implemented.

The following functions will be evaluated against the system functional specification during the thirty day test period:

10.1 Train Tracking

A further thirty days test of the functions as given in Phase 4 will be conducted, with these additional constraints also being met:

a) The system will now be required to track a maximum of 20 trains in the LIC subdivision.

b) The transponder reporting criteria will be shown to be consistently better than 99.8% based on each sample of 10,000 crossings taken within the defined test period. A minimum of four such samples will be taken to satisfy the overall reporting criteria.

c) It will be confirmed that the dual DCP and Host configurations can perform tracking functions without loss of performance when a single DCP or Host processor fails. It will also be verified that the DCPs still perform fallback tracking functions in the event of both Hosts failing.

d) All dispatcher assist functions will be operationally evaluated by the relevant B.C. Railway staff. This will include the graphics track diagram display, train sheets, reports and shift transfers in accordance with the LIC operating rules.

10.2 Train Control

Thirty days further evaluation of train control functions as given in Phase 5 will be undertaken, with the following additional criteria being met:

a) The system will now be demonstrated as being able to control the safe passage of 20 trains through the LIC subdivision at any one time.

b) It will be verified that no loss of train control functions or safety occur when a changeover from the main to standby system takes place.

c) The conflict prevention capabilities will be verified with the maximum number of trains in the subdivision when a changeover from the main to standby system takes place.

10.3 System Backup

It will be shown that no loss.of LIC functions results from failure of part or all of a DCP or Host processor system. Furthermore, the system will indicate such failures in order that the specified corrective action may be taken. The following criteria will be met to verify this function.

a) System configuration management: The system functions will be confirmed with the DCP-Host subsystem configuration system, backup and redundancy switching specification, GL6780-005. Furthermore, the failure detection and reporting functions for both the Host and DCP systems will be operationally verified.

b) Data base update: It will be verified that the off-line systems data base is regularly updated by the on-line system such that the off-line system is always ready to take control of the system. Specifically, the following two update links will be verified against the specification:

   i) Inter DCP link
   ii) Host system update link

c) Power fail recovery: The system will be shown to be able to recover from power outages in an orderly and safe manner. Furthermore, it will be verified that the same processors come up on-line when the power is restored as were so when the outage occurred. Power outages of from 1s to 1 hour will be initiated under various conditions of system loading.

10.4 Significant Events

The significant event reporting facility will be verified for the duration of the thirty day period. The following events will be logged and will form a record of system performance during test.

a) System alarms
b) System alerts
c) Abnormal occurrences
d) System events
e) Special function keyboard activities
f) Other user activities

10.5 System Operation

The operation, maintenance facilities and documentation will be evaluated in accordance with the criteria given in the functional specification. The test effort will confirm the following procedures:

a) System start up
b) Mode control and system configuration
c) Time consistency
d) Off-line software maintenance
e) Hardware maintenance

10.6 System Availability Evaluation

The overall system availability will be measured using field data obtained during the evaluation period. The measurement will be based on the system meeting an acceptable performance level (APL) for an operating period of thirty days.

11. DOCUMENTATION PLAN

It is proposed that the following documentation be kept during the course of the acceptance testing.

11.1 The Glenayre Project Engineer will keep a full log of all tests, results, remedial actions a comments made during test and acceptance. A copy of this log will be made available to B.C. Rail at their request.

11.2 A system of fault reporting will be employed to record the exact details of all failures. This will be implemented via a tabulated fault report form, an example of which is given in Appendix A3.

All equipment returned will be accompanied by a complete form specifying details of the unit and its mode of failure. In this way, more efficient fault analysis and a faster turn-around will be attained.

11.3 A comprehensive system test, check-list will be provided to accurately record acceptance of the functions checked during each test phase. The check list will contain itemized summaries of the functions being tested with provision for comments, the date tested and accepting signature. A sample check-list is contained in Appendix A4.

APPENDIX A1

UNIT TEST PROCEDURE

The constituent units of the LIC System will be individually tested to verify the performance of the unit against the specification.

Unit testing will fall into one of two categories:

1. Test of Glenayre manufactured units.
2. Test of units of proprietary manufacture.

Units of Glenayre Manufacture:

Units will be tested to the specified test procedure which will be based on the following criteria:

1. Visual inspection of wiring, PCBs and general assembly.
2. All switch and strap selectable options are set to the contract defined positions.
3. Basic parameter and function test includes:
    a) Power supply level check and adjustment.
    b) Check all frequencies, clock rates, input/output levels and where necessary, waveforms. If necessary, calibrate and fit select on test components.
    c) Measure unit power consumption and check power supply over-voltage and current limit where applicable.
4. Full performance test against specification.
5. Burn-in for at least forty-eight hours.
6. Retest of basic parameters and performance.

The above tests apply to the following units used in the LIC System:

1. Model GL 6110 Transponder
2. Model GL 6215 Interrogator
3. Model GL 6580A Engine Logic Unit

4. Model GL 6527 Cab Display Unit

5. Model GL 6782 Data Collection Processor

Units of Proprietary Manufacture:

The following procedure will be followed in testing proprietary equipment:

1. The units will be checked against the specification to ensure all options and features are correct.

2. The units will be tested against the specification in accordance with the procedures recommended by the manufacturer.

3. The units will be run for as long as possible while still under warranty. Where necessary, the units will be run under diagnostics during this period.

Responsibility for performing these tests will be divided between Glenayre and Datap, the units to which this procedure applies are given below:

Host Processor including all options	- PDP 11/44	Digital Equipment Corporation
Disc subsystem	- RL02	
Cartridge tape drive	- TU 58	
Video terminal	- VT100	
Printing terminal	- LA120	
High resolution monitor	Conrac 5411	
Display generator	Aydin Controls 5215	

APPENDIX A2

ACCEPTANCE TEST PLAN OVERVIEW

P D E
H L* D A V
A O A Y A
S C T S L
E N E N
RESPONSIBILITY DESCRIPTION

Function / System Tests

1	G	04	03	Train subsystem test, ELU/DCP protocol test and full DCP test using host simulator.	Glenayre
2a	G	04	01	Basic DCP tracking and train system control tests, using the communication link based at the Glenayre plant. The V-10 test vehicle will be tracked and controlled from NV to CP12 and return.	Glenayre BC Railway
2b	L	04	01	The DCP software will be integrated into the DCP at the LIC office. The V-10 will be tracked and controlled from NV to Squamish; thereby, exercising all implemented functions.	Glenayre BC Railway
3	L	05	04	Host system test, basic test of dispatcher assist functions, train control function entry and display, locally generated significant event reports, system procedures, and Host-DCP protocol. All implemented stand-alone functions of the Host will be evaluated prior to phase 4, 5 and 6 of the test plan as warranted by further software implementation.	Datap Glenayre

Field / Operations Tests

4	L	05	30	Train tracking and dispatcher assist tests using a single Host DCP configuration. The tests will satisfy schedule A, task 4e of the BC Rail work statement. The system will track a maximum of 20 LIC units or provisional	Glenayre Datap BC Railway

BC RAIL

PHASE	LOCN*	DATE	DAYS	EVALN	DESCRIPTION	RESPONSIBILITY
					trains for a period of 30 days of error free operation. In addition, during this period, the dispatcher assist functions will be fully evaluated, particularly the location accuracy of train symbols on the graphics display. System performance will be compared with previously established standards for calibration, radio coverage and transponder reporting statistics.	
5	L	07	60		Train control functions using a single Host DCP configuration. The tests will satisfy schedule A, task 6f of the BC Rail work statement. Train control functions will be monitored on a maximum of 20 units or provisional trains equipped for LIC operation.	Glenayre Datap BC Railway
6	L	09 - 10	30		Full system availability and pre-operational evaluation with a dual Host and dual DCP configuration. The tests will satisfy schedule A, task 7d of the BC Rail work statement. With the full system, the tests of phases 4 and 5 will be repeated. The system will be shown to be capable of handling 20 trains in the LIC subdivision. It will be assured the backup system can take over in the event of a failure in the on-line system. The system will be demonstrated as having met the requirements of the LIC Functional Specification (subject to project memo revisions) for a period of thirty days.	Glenayre Datap BC Railway

* LOCN KEY: G - Glenayre Plant
L - LIC Office

APPENDIX A3

LIC SYSTEM FAULT REPORT File No:____________________

A.

UNIT OR FUNCTION DESCRIPTION

1. Description (Function):________________________________
2. Type No.: ____________________________
3. Serial No.: __________________________
4. Version No.: _________________________

B.

FAULT DETAILS

5. Location of Unit: ______________________________________
6. Time and Date:__________________ On ____________________
7. Found By: ______________________ Of ____________________
8. Description of Fault:___________________________________

____

____

____

9. Possible Cause:_______________________________________

____

____

C.

ACTION TAKEN

10. Fault Resolved by: ______________ Of ____________________
11. Date: ___________________________
12. Fault Found and Action Taken: __________________________

____

____

____

13. Retested By on Date: ____________ On ____________________

D.

UNIT RETURNS

Before returning any equipment, contact IRENE ROBINSON at GLENAYRE, telephone number (604) 980-6041 and obtain a Repair Authorization Number.

14. Repair Authorization No.: ______________________________

BC RAIL

APPENDIX A4

LIC SYSTEM TEST CHECK LIST

PHASE	FUNCTION	COMMENTS	DATE	ACCEPTED
1.	DCP SYSTEM			
1.0	Train Subsystem			
2.0	DCP/ELU Communications Protocol			
3.1	Operator Interface			
3.2	Train Tracking Functions			
3.3	DCP/ELU Communications Handling			
3.4	DCP Reports			
3.5	Host/DCP Interface Handling (Simulated Host)			
3.6	Data Maintenance			
3.7	System Initialization			
2.	DCP BASIC TRACKING AND TRAIN CONTROL			
1.	Transponder Reporting			
2.	Odometer Calibration			
3.	Train Control Functions			
4.	DCP Reports			
5.	Communications System			
3.	HOST STAND-ALONE			
1.	Dispatcher Interface			
2.	Significant Events			
3.	Host/DCP Interface			
4.	Train Control Function Entry and Display			
5.	System Procedures			

BC RAIL

4. FULL TRAIN TRACKING WITH 13 LIC EQUIPPED TRAINS

1. Transponder Reporting
2. Odometer Calibration
3. Communications Coverage
4. Train Location
5. Dispatcher Assist Functions
6. System Loading

5. FULL TRAIN CONTROL EVALUATION

1. Train Control Operator Functions
2. Conflict Control
3. Cab Display Authorities and Directives
4. Graphics Track Diagram Display
5. Train Control Function Reporting

6. FULL SYSTEM AVAILABILITY AND PRE-OPERATIONAL EVALUATION

1. Train Tracking
2. Dispatcher Interface
3. Train Control
4. Significant Event Reporting
5. System Backup and Configuration
6. System Procedures
7. System Availability

BC RAIL

APPENDIX C

LOCATION IDENTIFICATION AND CONTROL SYSTEM OPERATING RULES

JANUARY 1, 1984

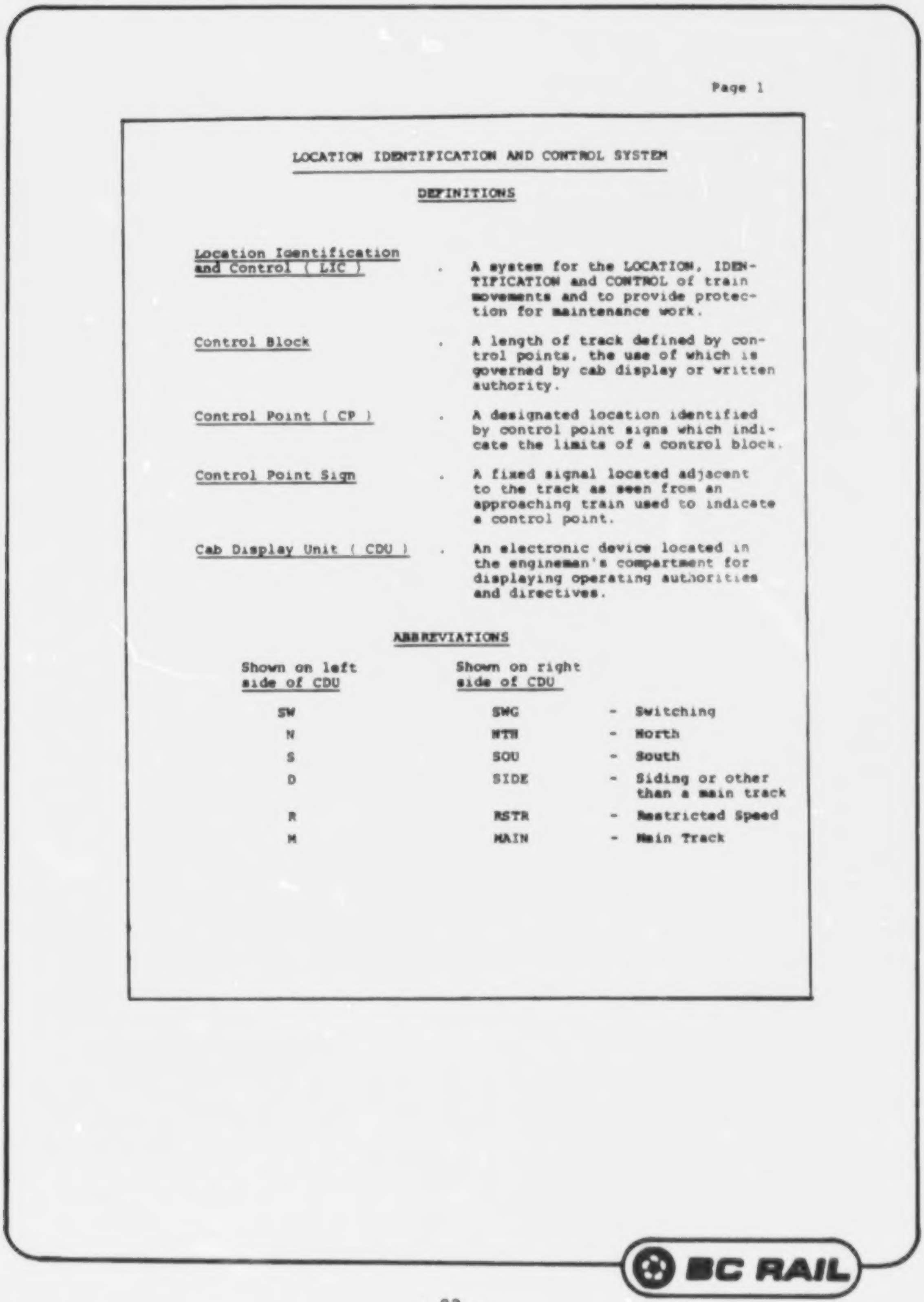
BC RAIL

LOCATION
IDENTIFICATION
AND CONTROL SYSTEM
OPERATING RULES

JAN 1, 1984

(Cover Sketch Courtesy of Swan Wooster Engineering)

BC RAIL



Page 1

LOCATION IDENTIFICATION AND CONTROL SYSTEM

DEFINITIONS

Location Identification and Control (LIC)	. A system for the LOCATION, IDENTIFICATION and CONTROL of train movements and to provide protection for maintenance work.
Control Block	. A length of track defined by control points, the use of which is governed by cab display or written authority.
Control Point (CP)	. A designated location identified by control point signs which indicate the limits of a control block.
Control Point Sign	. A fixed signal located adjacent to the track as seen from an approaching train used to indicate a control point.
Cab Display Unit (CDU)	. An electronic device located in the engineman's compartment for displaying operating authorities and directives.

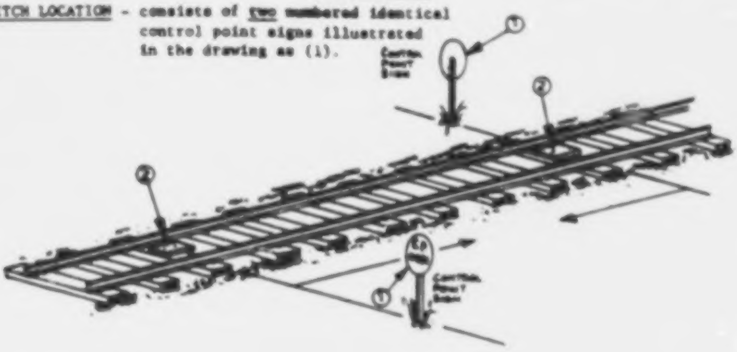
ABBREVIATIONS

Shown on left side of CDU	Shown on right side of CDU	
SW	SWG	- Switching
N	NTH	- North
S	SOU	- South
D	SIDE	- Siding or other than a main track
R	RSTR	- Restricted Speed
M	MAIN	- Main Track

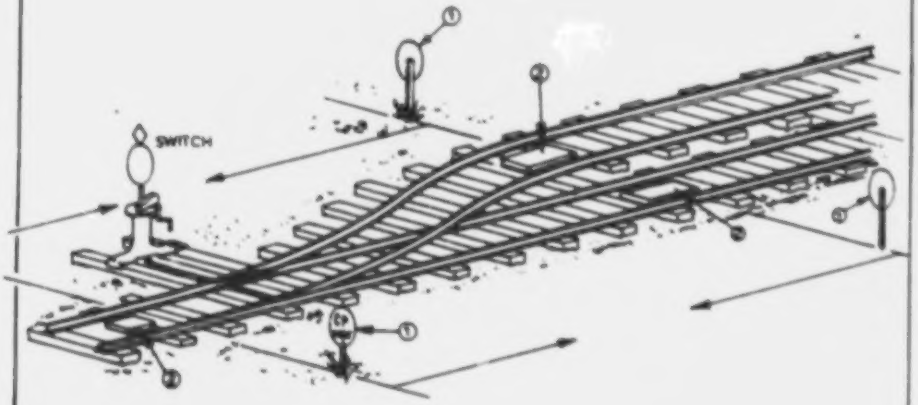
BC RAIL

CONTROL POINT

NON-SWITCH LOCATION - consists of two numbered identical control point signs illustrated in the drawing as (1).



SWITCH LOCATION - consists of three numbered identical control point signs illustrated in the drawing as (1).



CONTROL POINT SIGN ILLUSTRATION - Consists of the letters "CP" denoting control point. The four digits denote the control point number which is associated to the nearest tenth of the subdivision mileage.

TRANSPONDER - An electronic device mounted between the rails opposite the control point sign. When a L.I.C. equipped engine or caboose passes over a transponder, the transponder is activated and the engine or caboose reports passing that point. It is illustrated in the drawing as (2).

L.I.C. OPERATING RULES

L.I.C. 801 On subdivisions or portions of subdivisions specified in the time table or special instructions, trains and engines will be governed by Cab Display or Written Authorities. There is no superiority of trains in L.I.C. system. Numbered L.I.C. bulletins will give notice of track speed limits or other operating instructions.

Conductor and enginemen must be in possession of bulletins listed on their clearance before occupying a control block. Additional bulletins must be in writing, repeated and acknowledged to the train dispatcher.

The movement of trains will be supervised by the train dispatcher who will issue instructions as may be required. Except as affected by such instructions and L.I.C. Rules 801 to 810 and 901 to 910, all other U.C.O.R. rules remain in effect.

Engines may use the main track within yard limits as prescribed by U.C.O.R. Rule 93. When authorized by L.I.C. numbered bulletin addressed to the yard foreman, conductor or engineman, engines may move on the main track within yard limits on the time of first class trains. Advice may be received from the train dispatcher by the yardmaster, yard foreman, conductor or enginemen specifying actual arrivals and departures of first class trains. Such information must be copied in writing and repeated to the train dispatcher who will make a record in the L.I.C. bulletin book.

L.I.C. 802 Trains must be issued a L.I.C. clearance at initial stations and when a conductor or engineman or both are changed off or relieved enroute. Beginning at 0001 daily, consecutive numbers will be used to identify L.I.C. clearances. Clearances remain in effect until fulfilled or cancelled.

When L.I.C. clearances are issued to an operator, copies must be delivered to the conductor. When issued to the conductor only, he must make a copy for delivery to the engineman and when issued directly to a train, it will be copied simultaneously by the conductor and enginemen.

L.I.C. clearance not yet delivered by an operator to a train may be cancelled. The operator must acknowledge the intended cancellation and write the word "cancelled" and the time on the clearance being cancelled.

L.I.C. 803 Regular trains will be designated by numbers as "No. 2". Extra trains, except work extras are to be designated by engine number and direction as "Extra 234 North", "Passenger Extra 234 South", "Plow Extra 234 North". Work Extra will be designated as "Work Extra 234", "Plow Work Extra 234", etc. Extra trains will not display white flags. Engines will be designated as "Engine 234".

L.I.C. 804 When Cab Display or Written Authority is cancelled, protection is provided for trains on the main track and protection as prescribed by U.C.O.R. Rule 99 is not required. Before the train dispatcher cancels the protection, he must ascertain from the conductor and enginemen that the protection is no longer required.

CAB DISPLAY (805 - 810)

L.I.C. 805 Cab Display Route authorizes a train to pass a control point and occupy the control block to the next control point. This authorization must include a specific direction and route.

A train authorized by Cab Display Route or Restricted Route must move in the direction specified, reverse movements must be authorized by the train dispatcher.

Flag protection as prescribed by U.C.O.R. Rule 99 is not required except when a train or engine fouls the main track or passes a control point sign without authority.

When a train uses a main track switch under Cab Display Route or Restricted Route, the train dispatcher must be advised immediately after the switch has been restored to its normal position.

When conditions require a train to enter a control block at restricted speed, Cab Display Restricted Route Authority must be used. The authority must not be issued until the engine has stopped at the control point governing the control block. After a train has received Restricted Authority, no other Cab Display Operating Authority may be issued until the train has arrived at the end of the control block or the Cab Display Restricted Route Authority is cancelled. A train so authorized must move at restricted speed not exceeding fifteen (15) mph.

L.I.C. 806 Cab Display Switching authorizes a train to make switching movements over a control point and to occupy the control block or blocks on either side of the control point. The authority includes the use of all main track switches and other tracks within the specified limits. The train must occupy the control block or blocks where switching is required and hold no other operating authority. Train so authorized must move at restricted speed not exceeding fifteen (15) mph.

Note - Switching at non-control points requires authority from the train dispatcher.

L.I.C. 807 When practicable, a member of the crew on the rear of the train must voice communicate by radio with a member of the crew on the engine before leaving the initial station and at other points as required to obtain:

a) Operating Authority and Future Operating Authorities.

b) Directive displayed in the absence of Operating Authority.

L.I.C. 808 A train must be brought to a stop if possible before passing the next control point:

a) When the Operating Authority borders are not displayed.

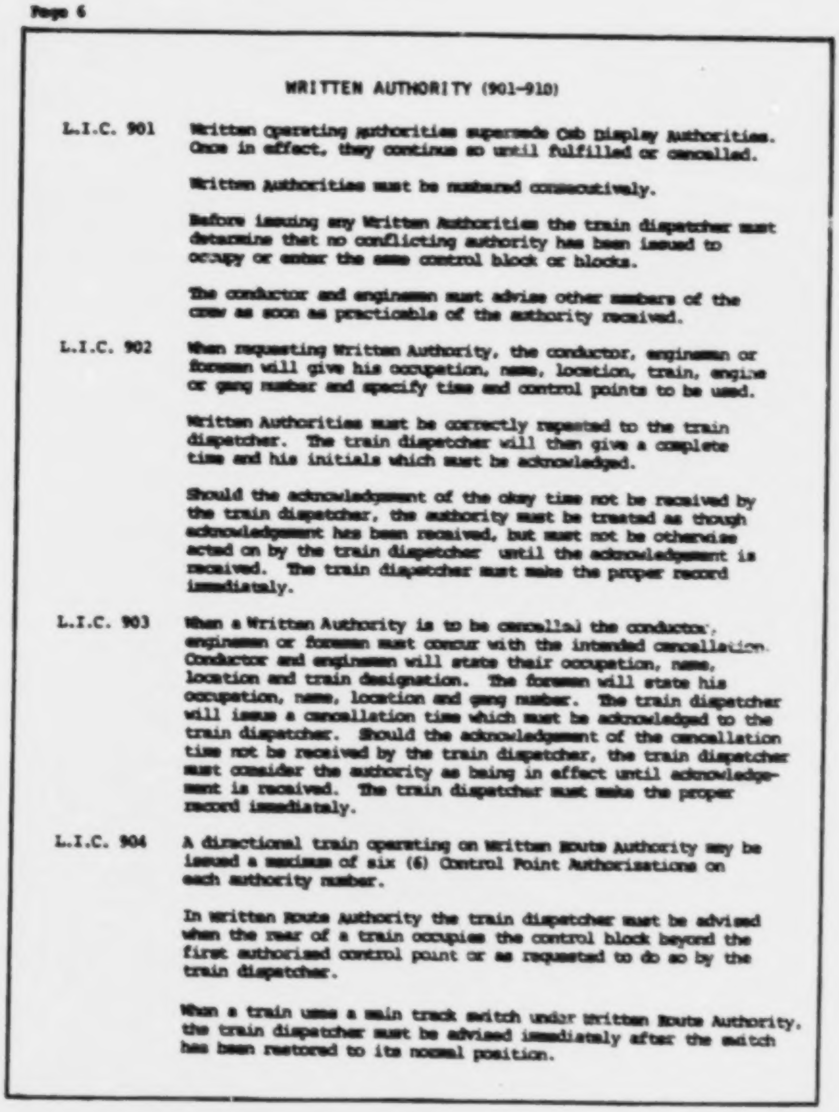
b) When a Cab Display Operating Authority or Directive is improperly displayed or is illegible.

Under these conditions, a member of the crew on the engine must immediately communicate with the train dispatcher stating occupation, name, location, train designation and be governed by his instructions.

Cab Display Operating authorities and Future Operating authorities once displayed, cannot be cancelled by the train dispatcher without the enginemen acknowledging the intended cancellation. The enginemen must advise other crew members of such cancellation.

L.I.C. 809 When a train is stopped at a control point, with no further authority and no conflicting movement is evident, a member of the crew must immediately communicate with the train dispatcher stating occupation, name, location and train designation and be governed by his instructions.

L.I.C. 810 When Cab Display authorities are displayed, only the Operating Authority is in effect. When a train occupies a control block beyond the authorized control point and roll up does not occur, the train must be brought to a stop before passing the next control point. A member of the crew must immediately communicate with the train dispatcher stating occupation, name, location and train designation and be governed by his instructions.



Page 6

WRITTEN AUTHORITY (901-910)

L.I.C. 901 Written operating authorities supersede Cab Display Authorities. Once in effect, they continue so until fulfilled or cancelled.

Written Authorities must be numbered consecutively.

Before issuing any Written Authorities the train dispatcher must determine that no conflicting authority has been issued to occupy or enter the same control block or blocks.

The conductor and engineman must advise other members of the crew as soon as practicable of the authority received.

L.I.C. 902 When requesting Written Authority, the conductor, engineman or foreman will give his occupation, name, location, train, engine or gang number and specify time and control points to be used.

Written Authorities must be correctly repeated to the train dispatcher. The train dispatcher will then give a complete time and his initials which must be acknowledged.

Should the acknowledgement of the okay time not be received by the train dispatcher, the authority must be treated as though acknowledgement has been received, but must not be otherwise acted on by the train dispatcher until the acknowledgement is received. The train dispatcher must make the proper record immediately.

L.I.C. 903 When a Written Authority is to be cancelled the conductor, engineman or foreman must concur with the intended cancellation. Conductor and engineman will state their occupation, name, location and train designation. The foreman will state his occupation, name, location and gang number. The train dispatcher will issue a cancellation time which must be acknowledged to the train dispatcher. Should the acknowledgement of the cancellation time not be received by the train dispatcher, the train dispatcher must consider the authority as being in effect until acknowledgement is received. The train dispatcher must make the proper record immediately.

L.I.C. 904 A directional train operating on Written Route Authority may be issued a maximum of six (6) Control Point Authorisations on each authority number.

In Written Route Authority the train dispatcher must be advised when the rear of a train occupies the control block beyond the first authorised control point or as requested to do so by the train dispatcher.

When a train uses a main track switch under Written Route Authority, the train dispatcher must be advised immediately after the switch has been restored to its normal position.

BC RAIL

L.I.C. 905 A work extra may be issued Exclusive, Dual or Joint Work Authority.

A work extra in possession of Work Authority may move in either direction within the specified limits. The authority includes the use of all tracks within the specified limits. A work extra may be authorized to pass a control point to enter the specified limits.

L.I.C. 906 Maintenance foreman may be issued Exclusive or Joint work authority. Such authority does not provide protection against other track units. The foreman must ensure that at least one other employee has a proper understanding of the authority. Work authorities remain in effect until cancelled.

When Joint Work Authority or Exclusive Maintenance Work Authority is issued to a maintenance foreman, limits will be defined by control points and the display of flags as prescribed by U.C.O.R. Rule 42 is not required.

L.I.C. 907 The train dispatcher must maintain within the system the protection issued under Work Authority until cancelled.

L.I.C. 908 Dual Work Authority must be issued direct to conductor and engineman of the work extras affected. Each work extra must be instructed to "protect against each other" and must have a thorough understanding in writing as to the movements of each other and the protection to be provided. Should communications fail, movements must not be made beyond the last point arranged.

L.I.C. 909 When a work extra and a maintenance foreman are to use the same limits, Joint Work Authority must be issued directly to conductor, engineman and foreman. They must have a thorough understanding in writing as to the movements of each other. Should communications fail, movements must not be made beyond the point last arranged.

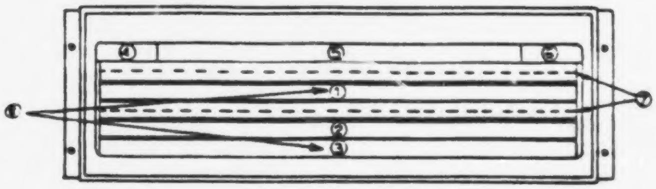
L.I.C. 910 When transfering, train dispatchers must have a clear and proper understanding of necessary information, both must sign the transfer showing all authorities and bulletins in effect.

CONTROL POINT NUMBERS LOCATIONS	SQUAMISH SUBDIVISION
	STATIONS
0025	... NORTH VANCOUVER ...
0031	... AMBLESIDE ...
0060	
0090	
0116	
0130	
0186 0200	... BRUNSWICK ...
0230	
0253 0263	... PORTEAU ...
0301	
0341	
0380	
0391 0408	... SQUAMISH ...
0421	
0461	
0492 0502	... CHEAKAMUS ...
0551	
0591 0602	... GARIBALDI ...
0631	
0665 0679	... McGUIRE ...
0711	
0748	
0766 0779	... MONS ...
0821	
0863	
0899 0910	... TISDALL ...
0932	
0951	... PEMBERTON ...
0980	... EVANS ...
1031	
1056 1067	... CREEKSIDE ...
1091	
1119 1131	... BIRKEN ...
1161	
1191	
1225 1235	... DARCY
1251	
1303	... MARNE
1351	
1388 1399	... SETON ...
1441	
1487 1498	... RETASKIT ...
1520	
1555	
1565	
	... LILLOOET ...

NOTE: C.P. NOS. CORRESPOND TO SUBDIVISION MILEAGE TO THE NEAREST TENTH OF A MILE.

CAB DISPLAY UNIT (CDU)

Pictorial Reference



(1) Operating authority

(2) Future operating authority

(3) Future operating authority

(4) Speedometer reading, registered to nearest tenth of a mile per hour.

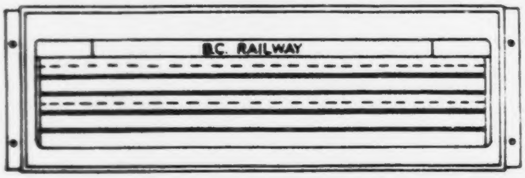
(5) Directive area, see illustrations on pages 10, 11, 12 & 13.

(6) Odometer reading, registering subdivision mileage to the nearest tenth of a mile.

(7) Two rows of dotted lines which border the operating authority.

(8) Operating authorities displayed in areas 1, 2 & 3 are presented in two forms which must correspond. See illustrations on pages 14, 15 & 16.

DIRECTIVES

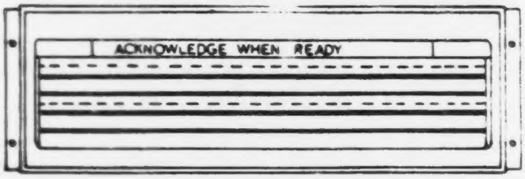


DESCRIPTION

Information to the engineman that the directive area of the cab display is operating. B.C. Railway will always be displayed when other directives are not required.

ACTION REQUIRED

None



DESCRIPTION

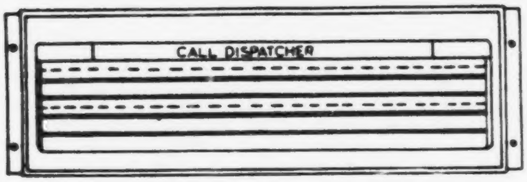
Initiated by the train dispatcher at the initial station and accompanied by a two second audible tone.

When the acknowledge button is pressed, the directive will be removed and operating authorities may be received.

ACTION REQUIRED

Engineman acknowledge by pressing the acknowledge button when ready to receive operating authorities.

DIRECTIVES



DESCRIPTION

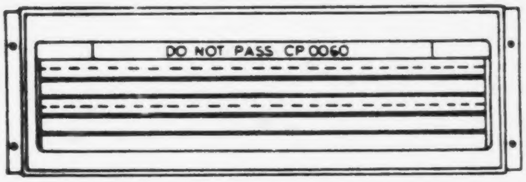
The train dispatcher requesting voice radio communication with the engineman.

This directive is accompanied by a two second audible tone which is repeated every thirty seconds until acknowledged.

When the acknowledge button is pressed, the directive will be removed.

ACTION REQUIRED

Engineman acknowledge by pressing the acknowledge button and initiate voice communication with the train dispatcher.



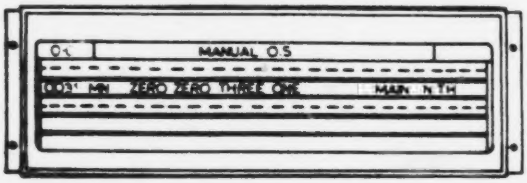
DESCRIPTION

This directive indicates where operating authority ceases.

ACTION REQUIRED

Stop before fouling designated control point.

DIRECTIVES



DESCRIPTION

The action initiated by the train dispatcher when the engineman has reported that the engine has passed a control point, and the operating authority has not rolled up.

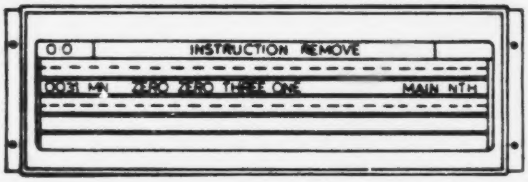
The directive is accompanied by a two second audible tone, and if not acknowledged within twenty seconds, the directive will be removed and the operating authority will remain.

By pressing the acknowledge button, the directive will be removed and the operating authority will roll up

ACTION REQUIRED

The train must be brought to a stop before passing the next control point.

The engineman acknowledges by pressing the acknowledge button to initiate the operating authority roll up.



DESCRIPTION

Initiated by the train dispatcher when operating authorities are displayed, and the train dispatcher is requesting the engineman's permission to remove them.

This directive is accompanied by a two second audible tone, and if not acknowledged within twenty seconds, the directive will be removed and the operating authority will remain.

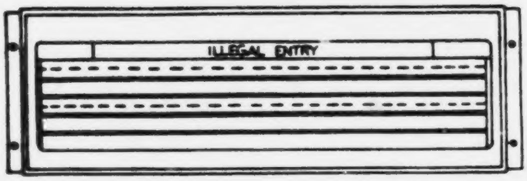
By pressing the acknowledge button within twenty second time frame, the directive and last issued operating authority displayed will be removed.

This procedure must be repeated for each operating authority removal.

ACTION REQUIRED

If engineman concurs with the intended removal, he acknowledges by pressing the acknowledge button.

DIRECTIVES



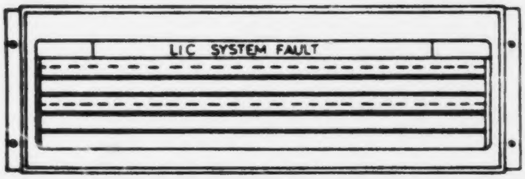
DESCRIPTION

When a train or engine fouls a control point sign or occupies a control block without operating authority, this directive will appear.

The directive will be accompanied by a two second audible tone, and will remain until removed by the train dispatcher.

ACTION REQUIRED

The train must be brought to a stop, flag protection must be provided by U.C.O.R. Rule 99, and a member of the crew must communicate with the train dispatcher immediately.



DESCRIPTION

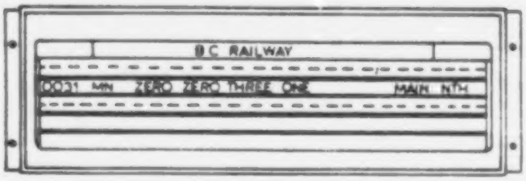
When a L.I.C. equipment failure is detected, this directive will be displayed and accompanied by a two second audible tone.

The directive will remain until acknowledge button is pressed.

ACTION REQUIRED

The train must be brought to a stop before passing the next control point if possible and voice communication must be established with the train dispatcher.

OPERATING AUTHORITIES

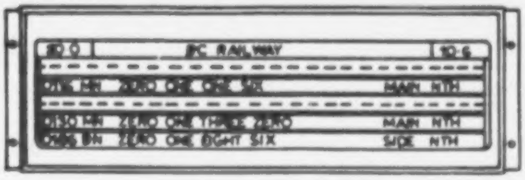

B C RAILWAY
0031 MN ZERO ZERO THREE ONE
MAIN NTH

CAB DISPLAY ROUTE

AUTHORITY INDICATED

The train has operating authority to pass control point 0031 on main track, and proceed northward occupying the control block to the next control point.

OPERATING AUTHORITIES

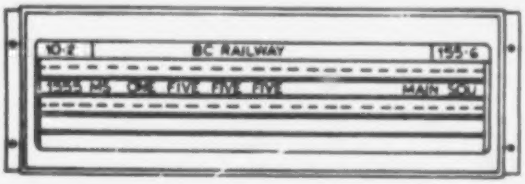

80·0
BC RAILWAY
10·6
0116 MN ZERO ONE ONE SIX MAIN NTH
0130 MN ZERO ONE THREE ZERO MAIN NTH
0186 SN ZERO ONE EIGHT SIX SIDE NTH

CAB DISPLAY ROUTE

AUTHORITY INDICATED

Train may pass control point 0116 via main track, occupy the control block, and proceed northward to control point 0130.

In this example, control point 0130 and 0186 are future operating authorities only and must not be acted upon.

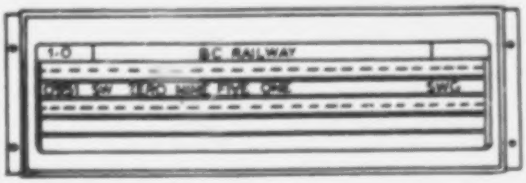

10·2
BC RAILWAY
155·6
1555 MS ONE FIVE FIVE FIVE MAIN SOU

CAB DISPLAY ROUTE

AUTHORITY INDICATED

Train may pass control point 1555 via main track, occupy the control block and proceed southward to the next control point.

OPERATING AUTHORITIES


1-0
BC RAILWAY
0951 SW ZERO NINE FIVE ONE
SWG

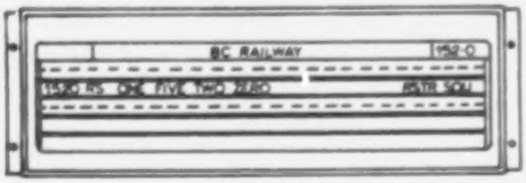
CAB DISPLAY SWITCHING

AUTHORITY INDICATED

Train may move in either direction and occupy the control blocks on both sides of control point 0951.

Other control points must not be fouled and this authority remains displayed until cancelled.

Trains so authorized must move at restricted speed not exceeding fifteen (15) mph.

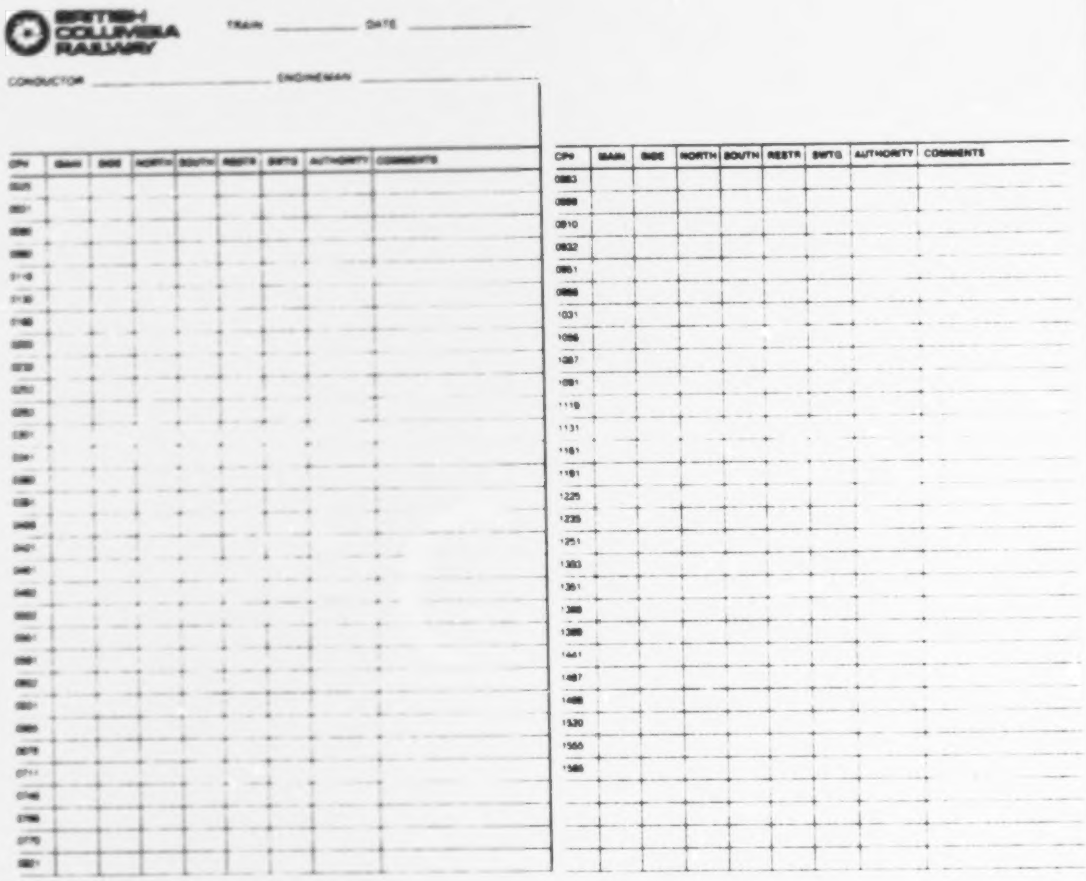

BC RAILWAY
152-0
1520 RS ONE FIVE TWO ZERO
RSTR SOU

CAB DISPLAY RESTRICTED ROUTE

AUTHORITY INDICATED

Train may pass control point 1520 via main track and occupy the control block, proceeding southward at restricted speed not exceeding fifteen (15) mph to the next control point.

This operating authority remains displayed until cancelled.



BRITISH COLUMBIA RAILWAY

TRAIN ______ DATE ______

CONDUCTOR ______ ENGINEMAN ______

CP#	MAIN	SIDE	NORTH	SOUTH	RESTR	SWTG	AUTHORITY	COMMENTS
[illegible]								
[illegible]								
[illegible]								
[illegible]								
[illegible]								
[illegible]								
[illegible]								
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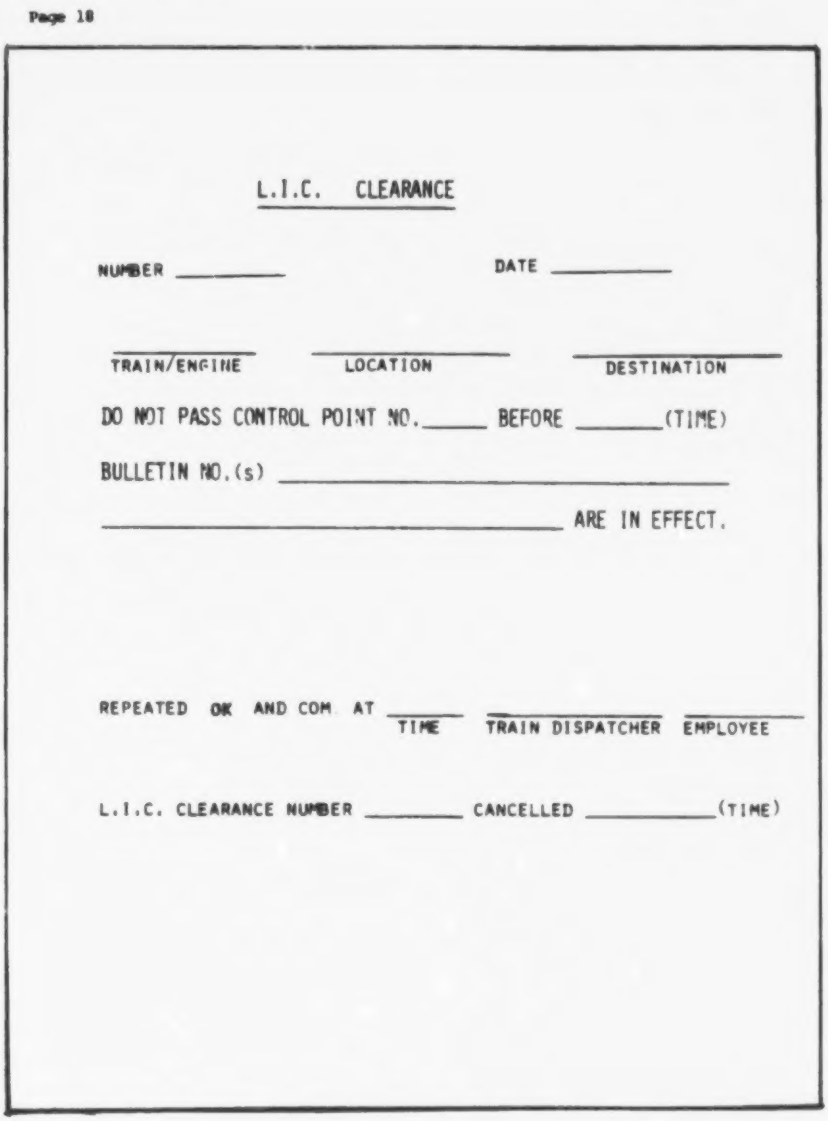
[illegible]								
0711								
[illegible]								
[illegible]								
[illegible]								
[illegible]								

CP#	MAIN	SIDE	NORTH	SOUTH	RESTR	SWTG	AUTHORITY	COMMENTS
0883								
[illegible]								
0910								
0932								
0951								
[illegible]								
1031								
1056								
1087								
1091								
1119								
1131								
1161								
1191								
1225								
1235								
1251								
1303								
1351								
[illegible]								
[illegible]								
1441								
1487								
[illegible]								
1520								
1555								
1586								



Page 18

L.I.C. CLEARANCE

NUMBER ________ DATE ________

________ ________ ________

TRAIN/ENGINE LOCATION DESTINATION

DO NOT PASS CONTROL POINT NO. ____ BEFORE ______ (TIME)

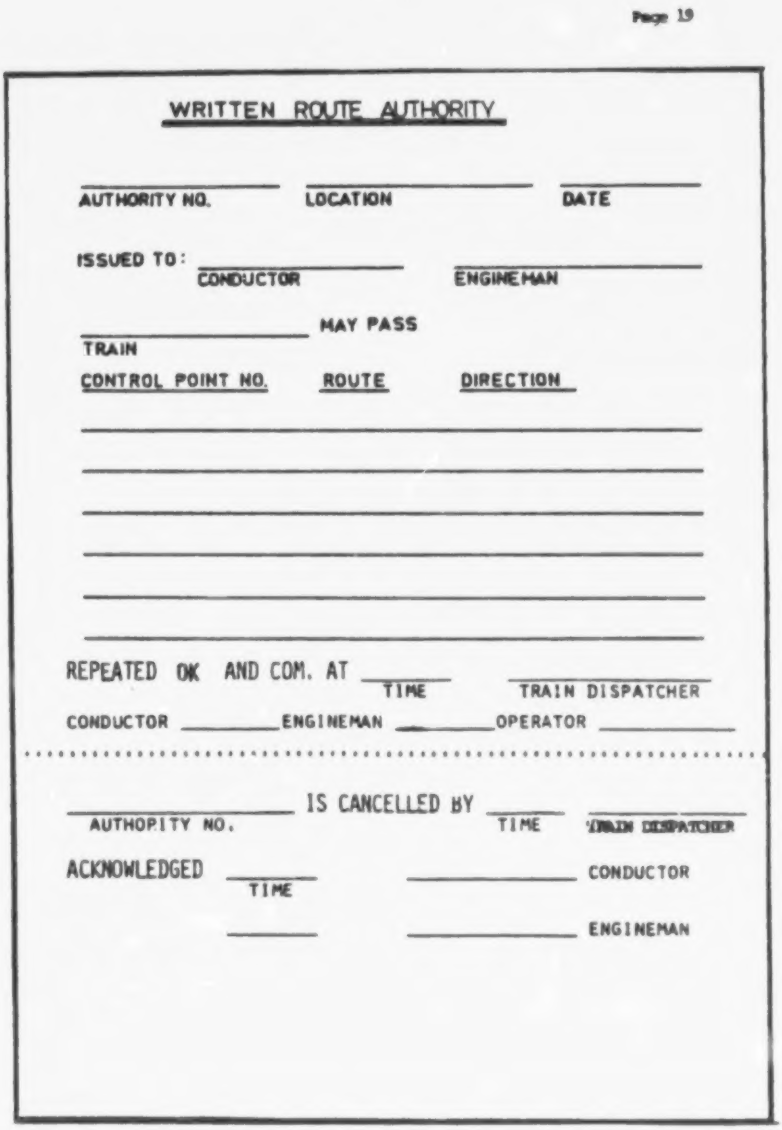
BULLETIN NO.(s) ____________________

____________________ ARE IN EFFECT.

REPEATED OK AND COM. AT ______ ______ ______

TIME TRAIN DISPATCHER EMPLOYEE

L.I.C. CLEARANCE NUMBER ______ CANCELLED ________ (TIME)



Page 19

WRITTEN ROUTE AUTHORITY

AUTHORITY NO. ____ LOCATION ____ DATE ____

ISSUED TO: ____ CONDUCTOR ____ ENGINEMAN

____ TRAIN MAY PASS

CONTROL POINT NO. ROUTE DIRECTION

REPEATED OK AND COM. AT ____ TIME ____ TRAIN DISPATCHER

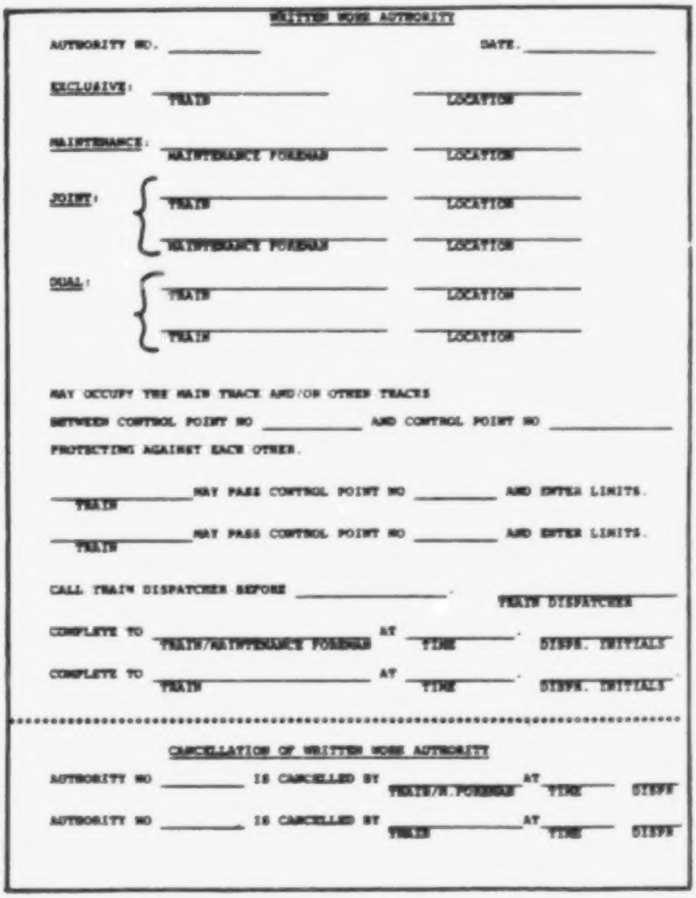
CONDUCTOR ____ ENGINEMAN ____ OPERATOR ____

....

____ AUTHORITY NO. IS CANCELLED BY ____ TIME ____ TRAIN DISPATCHER

ACKNOWLEDGED ____ TIME ____ CONDUCTOR

____ ____ ENGINEMAN



WRITTEN WORK AUTHORITY

AUTHORITY NO. ____________ DATE. ________________

EXCLUSIVE: ________________ TRAIN ________________ LOCATION

MAINTENANCE: ________________ MAINTENANCE FOREMAN ________________ LOCATION

JOINT:
- ________________ TRAIN ________________ LOCATION
- ________________ MAINTENANCE FOREMAN ________________ LOCATION

DUAL:
- ________________ TRAIN ________________ LOCATION
- ________________ TRAIN ________________ LOCATION

MAY OCCUPY THE MAIN TRACK AND/OR OTHER TRACKS
BETWEEN CONTROL POINT NO ____________ AND CONTROL POINT NO ______________
PROTECTING AGAINST EACH OTHER.

________________ TRAIN MAY PASS CONTROL POINT NO __________ AND ENTER LIMITS.

________________ TRAIN MAY PASS CONTROL POINT NO __________ AND ENTER LIMITS.

CALL TRAIN DISPATCHER BEFORE __________________. ________________ TRAIN DISPATCHER

COMPLETE TO ________________ TRAIN/MAINTENANCE FOREMAN AT __________ TIME. __________ DISPR. INITIALS

COMPLETE TO ________________ TRAIN AT __________ TIME. __________ DISPR. INITIALS

....

CANCELLATION OF WRITTEN WORK AUTHORITY

AUTHORITY NO __________ IS CANCELLED BY ________________ TRAIN/M.FOREMAN AT __________ TIME __________ DISPR

AUTHORITY NO __________ IS CANCELLED BY ________________ TRAIN AT __________ TIME __________ DISPR

USES OF WRITTEN WORK AUTHORITIES

EXCLUSIVE	. WORK LIMITS WHICH PROVIDE PROTECTION FOR ONE WORK EXTRA
DUAL	. WORK LIMITS WHICH PROVIDE PROTECTION FOR TWO WORK EXTRAS TO WORK WITHIN THE SAME LIMITS.
JOINT	. WORK LIMITS WHICH PROVIDE PROTECTION FOR A WORK EXTRA AND A MAINTENANCE FOREMAN WITHIN THE SAME LIMITS.
EXCLUSIVE MAINTENANCE	. WORK LIMITS WHICH PROVIDE PROTECTION FOR MAINTENANCE FOREMAN.

BC RAIL

APPENDIX D

DETAILED SOFTWARE ACCEPTANCE TEST PROCEDURE SHEETS

FOR CONFLICT CONTROL

HOST SOFTWARE VERSION 3.41

DCP SOFTWARE VERSION 6.05

DATES TEST CONDUCTED

START: AUGUST 22, 1983
FINISH: AUGUST 29, 1983

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 1

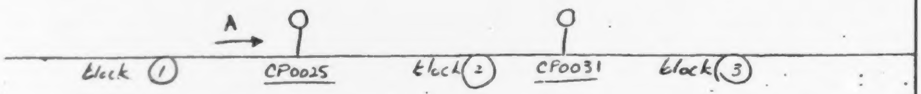
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb. 17, 83

TEST DESCRIPTION: Issue Cab Display / ~~Written Main Route~~

SET UP: Train A initialized + has no authorities yet. It's intended direction of travel is north. No restrictions on CP0025; block ② is empty and no train has authority in there.



NOTES:

ACTIONS	RESULTS
sue CD/WR Main Route to train A ver CP0025, direction North / Execute	1. Accepted by Host + DCP

COMMENTS:

TEST CONFIRMED BY: Ch

DATE: Aug 22/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 2

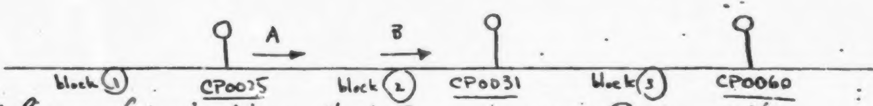
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb. 17,83

TEST DESCRIPTION: Issue Cab Display/Written Main Route

SET UP: Train A initialized; intended direction of travel is north. No restrictions on CP0031, block ③ is empty and no train has authority in there. Train A holds Restricted Route over CP0025 and train B is in block ② under CD Main Route



NOTES: Reason for rejection: Host Spec, p. 5-27 Pre-requisite.

ACTIONS	RESULTS
ssue CD/WR Main Route to train A over P0031, direction north / Execute	1. Rejected by Host

COMMENTS:

ERROR MSG. OTHER AUTH HELD HOST

TEST CONFIRMED BY: OK

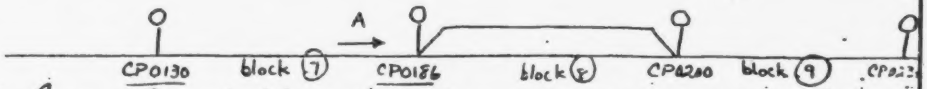
DATE: aug 22/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC
TEST NO: 3
TEST PHASE: CONFLICT
PREPARED BY: MG
DATE: Feb. 17, 83
TEST DESCRIPTION: Issue Cab Display/Written Main Route

SET UP: Train A initialized, intended dir. of travel is north. No restriction on CP0200; block ⑨ is empty and no train has authority in there. Train A holds Switching authority over CP0186.



NOTES: Reason for rejection: Host Spec. page 5-27 pre-requisite

ACTIONS	RESULTS
ssue CD/WR Main Route to train A over CP0200, direction north /Execute	1. Rejected by Host

COMMENTS: ERR OTHER AUTH HELD HOST

TEST CONFIRMED BY: OK
DATE: aug 24/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 4

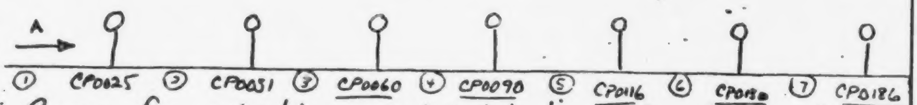
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb. 17, 83

TEST DESCRIPTION: Issue Cab Display/Written Main Route

SET UP: Train A initialized; intended direction of travel is north. No restriction on CP0186; block ⑧ is empty and no train ha authority in there. Train A holds CD Main Route authority over CP0025, CP0031, CP0060, CP0090, CP0116 and CP0130, dir. nort



NOTES: Reason for rejection: CD/[illegible] instruction buffer already full.

ACTIONS	RESULTS
ssue CD/[illegible] Main Route to train A ver CP0186, direction north / Execute	1. Rejected by Host

COMMENTS:

TO MANY CDRS HOST

TEST CONFIRMED BY: OK

DATE: Aug 22/8

BC RAIL

SYSTEM: LIC

TEST NO: 5

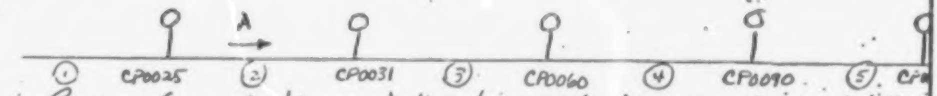
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb. 17, 83

TEST DESCRIPTION: Issue Cab Display / ~~Written Main Route~~

SET UP: Train A initialized; intended direction of travel is north. No restriction on CP0090; block ⑤ is empty and no train has authority in there. Train A is occupying block ② under CD Main Route, north and holds CD Main, north over CP0031.



NOTES: Reason for rejection: Authorities not in sequence, Host Sp
p. 5-37 prerequisite.

ACTIONS	RESULTS
sue CD/~~WR Main Route~~ to train A over CP0090, direction north / Execute	1. Rejected by Host

COMMENTS:

INVALID SEQU HOST

TEST CONFIRMED BY: OK

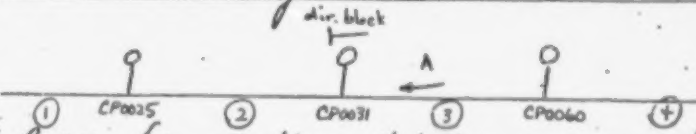
DATE: ~~[illegible]~~ Ag 24/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC
TEST NO: 6
TEST PHASE: CONFLICT
PREPARED BY: MG
DATE: Feb. 17, 83
TEST DESCRIPTION: Issue Cab Display / Written Main Route

SET UP: Train A initialized, intended direction of travel is south. Train A occupying block ③ under CD Main Route over CP0060, direction south.
CP0031 directionally blocked in the direction south.



NOTES: Reason for rejection: Host Spec., p. 5-27 conflict check – CP is blocked in direction of authority.

ACTIONS	RESULTS
sue CD/WR Main Route to train A over P0031, direction south / Execute	1. Rejected by Host and DCP.

COMMENTS:
CP Blocked Host

OK

TEST CONFIRMED BY:

DATE: Aug 25/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 7

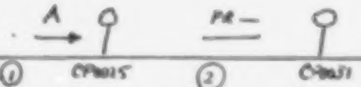
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb. 17, 83

TEST DESCRIPTION: Issue Cab Display/Written Main Route

SET UP: Train PR— is an unauthorized train occupying block ②
Train A is initialized, its intended direction of travel is nort
No restriction on CP0025.



NOTES: Reason for rejection: Associated block is occupied.

ACTIONS	RESULTS
ssue CD/WR Main Route to train A ver CP0025, direction north /Execute	1. Rejected by Host + DCP.

COMMENTS:

"Block in use"

TEST CONFIRMED BY: OK

DATE: Aug 25/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 8

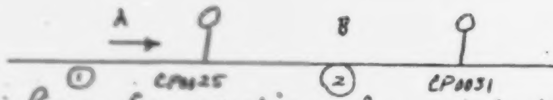
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb. 17,83

TEST DESCRIPTION: Issue Cab Display / Written Main Route

SET UP: Train A initialized; its intended direction of travel is north. Foreman B has Exclusive Maintenance of Way Work Authority between CP0025 and CP0031



NOTES: Reason for rejection: Associated block is given to a MoW crew under work authority.

ACTIONS	RESULTS
sue CD/WR Main Rout to train A ver CP0025, direction north / Execute	1. Rejected by Host.

COMMENTS:

ERROR MESSAGE BLOCK IN USE

TEST CONFIRMED BY: OK

DATE: Aug 22/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 9

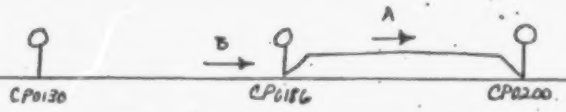
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb. 17, 83

TEST DESCRIPTION: Issue Cab Display / Written Main Route

SET UP: Train B is initialized; its intended direction of travel is n
Train A is occupying the siding under CD route over CP01
direction north.



NOTES:

ACTIONS	RESULTS
ue CD/WR Main Route to train B r CP0186, direction north / Execute	1. Accepted by Host + DCP

COMMENTS:

TEST CONFIRMED BY: OK

DATE: Aug 25/83

BC RAIL

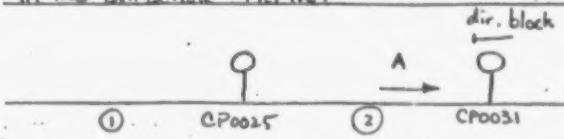
TEST PROCEDURE

SYSTEM: LIC TEST NO: 10

TEST PHASE: CONFLICT PREPARED BY: MG DATE: Feb. 17 '83

TEST DESCRIPTION: Issue Cab Display/~~Written Main Route~~

SET UP: Train A initialized; its intended direction of travel is north
CP0031 blocked in the direction north.
Train A occupying block ② under CD Main Route over CP0025
in the direction north.



NOTES:

ACTIONS	RESULTS
ssue CD/~~wr~~ Main Route to train A ver CP0025, direction north /Execute	1. Accepted by Host + DCP.

COMMENTS:

TEST CONFIRMED BY: ok

DATE: aug 22/83

BC RAIL

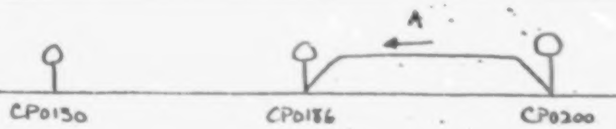
TEST PROCEDURE

SYSTEM: LIC **TEST NO:** 11

TEST PHASE: CONFLICT **PREPARED BY:** MG **DATE:** Feb. 17, 83

TEST DESCRIPTION: Issue Cab Display/Written Main Route

SET UP: Train A initialized; its intended direction of travel is sout
Train A occupying the siding under CD Siding Ro
over CP0200, direction south



NOTES:

ACTIONS	RESULTS
Issue CD/WR Main Route to train A over CP0186, direction south / Execute	1. Accepted by Host + DCP.

COMMENTS:

TEST CONFIRMED BY: ok

DATE: Aug 25 /83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 12

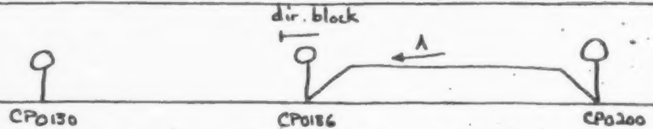
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb. 17, 83

TEST DESCRIPTION: Issue Cab Display/Written Main Route

SET UP: Train A initialized; its intended direction of travel is south. Train A occupying the siding under CD siding route over CP0200 direction south. CP0186 blocked in the direction south



NOTES: Reason for rejection: The CP is blocked in direction of authority.

ACTIONS	RESULTS
ssue CD/WR Main Route to train A over CP0186, direction south /Execute	1. Rejected by Host + DCP.

COMMENTS:

ERR MSG
CP BLOCKED HOST

TEST CONFIRMED BY: ~~CP BLOCKED~~ · OK

DATE: Aug 25/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 13

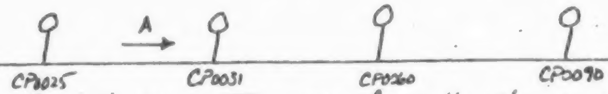
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb. 17, 93

TEST DESCRIPTION: Issue Cab Display / ~~Written Main Route~~

SET UP: Train A initialized, its intended direction of travel is north. Train A holds Written Exclusive Work Authority between CP0025 and CP0090.



NOTES: Reason for rejection: The CP of authority is inside the boundaries of the train's work authority. (Host Spec, p. 5-27)

ACTIONS	RESULTS
ssue CD/~~WR Main Route~~ to train A over CP0031, direction north / Execute	1. Rejected by Host.

COMMENTS: Other auth held Host

TEST CONFIRMED BY: OG

DATE: AUG-22/87

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 14

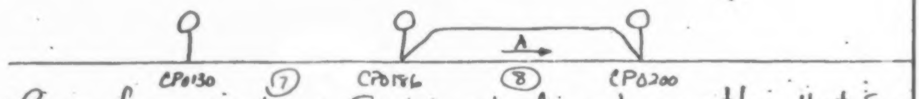
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb. 17, 83

TEST DESCRIPTION: Issue Cab Display / Written Main Route

SET UP: Train A initialized, its intended direction of travel is nolk
Train A occupying block ⑧ under CD main route over
CP0186, direction north.
Switch at CP0200 not aligned. main-to-main



NOTES: Reason for rejection: Switch not aligned correctly - Host Sp
p.5-27)

ACTIONS	RESULTS
Issue CD/WR Main Route to train A over CP0200, direction north / Execute	1. Rejected by Host.

NOTE DID ~~THIS TEST AT [illegible]~~
HLPRS [illegible] SWC. TRIED AFTER HLPR
CLEARED CHECK WG.

COMMENTS:

SWITCH ALIGNMT HOST

TEST CONFIRMED BY:

DATE: aug 24/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 15

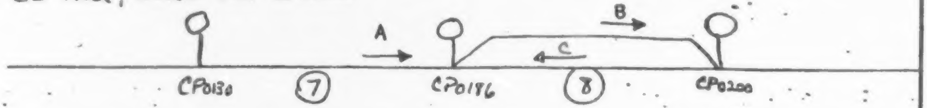
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb. 18, 83

TEST DESCRIPTION: Issue Cab Display/~~Written~~ Siding Route

SET UP: Train A initialized; its intended direction of travel is north. Train A occupying block ⑦ under CD Main Route over CP0130, direction north. Train B occupying the siding under CD Route, north. Train C occupying block ⑧ unde CD route, south over CP0200.



NOTES:

ACTIONS	RESULTS
ssue CD/WR Siding Route to train A, over CP 0186, direction north / Execute	1. Accepted by Host + DCP

COMMENTS:

TEST CONFIRMED BY: Ok

DATE: aug 25/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 16

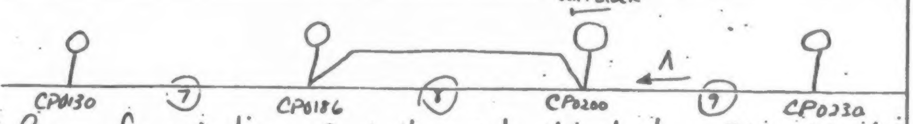
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb. 18, 83

TEST DESCRIPTION: Issue Cab Display / Written Siding Route

SET UP: Train A initialized, occupying block ⑨ under CD Main Route, direction south over CP0230.
CP0200 blocked in the direction south.



NOTES: Reason for rejection: Control point blocked in the directi
of authority.

ACTIONS	RESULTS
Issue CD/WR Siding Route to train A over CP0200, direction South / Execute	1. Rejected by Host + DCP.

COMMENTS: 1 "CP Blocked (Host)

OK

TEST CONFIRMED BY:

DATE: Aug 26/83

BC RAIL

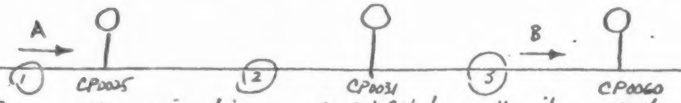
TEST PROCEDURE

SYSTEM: LIC TEST NO: 17

TEST PHASE: CONFLICT PREPARED BY: MG DATE: Feb 18,8

TEST DESCRIPTION: Issue Cab Display/Written Restricted Route

SET UP: Train A initialized, its intended direction of travel is nort
Train A holds Written Main Route over CP0025, north.
Train B occupies block ③ under CD Main Route over CP003
north.



NOTES: Reason for rejection: Unfulfilled authority still held by the train.

ACTIONS	RESULTS
ssue CD/WR Restricted Route to train A ver CP0031 direction north / Execute	1. Rejected by the Host.

COMMENTS:
ERR MSG
OTHER AUTH
HELD HOST

C.K. DATE: Aug 25/87

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 18

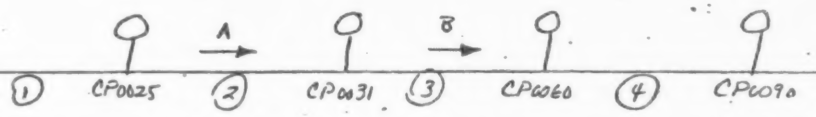
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb. 21, 83

TEST DESCRIPTION: Issue Cab Display /Written Restricted Route

SET UP: Train B occupying block ③ under Cab Display Main Route north over CP0031.
Train A occupying block ② under CD Main, north over CP0025



NOTES:

ACTIONS	RESULTS
Issue CD/WR Restricted Route to train A over CP0031, north /Execute	1. Accepted by Host + DCP.

COMMENTS:

TEST CONFIRMED BY: mk

DATE: Aug 23/83

BC RAIL

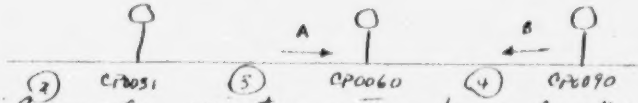
TEST PROCEDURE

SYSTEM: LIC TEST NO: 19

TEST PHASE: CONFLICT PREPARED BY: MG DATE: Feb. 21, 83

TEST DESCRIPTION: Issue Cab Display / Written Restricted Route

SET UP: Train B occupying block ④ under CD Main, south over CP0
Train A occupying block ③ under CD Main, north over CP0



NOTES: Reason for rejection: Two trains travelling in opposite directions.

ACTIONS	RESULTS
Issue CD/WR Restricted Route to train A over CP0060, north / Execute	1 Rejected by Host and DCP.

COMMENTS: "Block in use Host"

TEST CONFIRMED BY: DATE: Aug 26/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 20

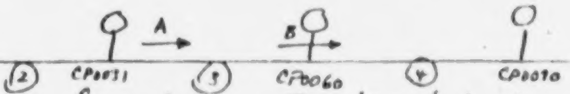
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb 21,83

TEST DESCRIPTION: Issue Cab Display/Written Restricted Route

SET UP: Train B occupying blocks ③ + ④ (i.e. its EOT has no cleared block ③ yet. It has CD Main, north over CP0060. Train A occupying block ③ under CD Restricted Route, north over CP0031.



NOTES: Reason for rejection: Preceding train has not cleared the control point yet.

ACTIONS	RESULTS
ue CD/WR Restricted Route to train A er CP0060, north / Execute	1. Rejected by Host + DCP.

COMMENTS:

OTHER AUTH HELD HOST

TEST CONFIRMED BY:

DATE: aug 23/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 21

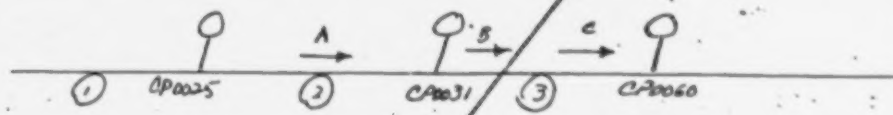
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb 21, 83

TEST DESCRIPTION: Issue Cab Display / Written Restricted Route

SET UP: Train A occupying block ② under CD Main, north over CP0025. Train B occupying block ③ under CD Restricted Route over CP0031, north. Train C occupying block ③ under CD Main, north over CP0031.



NOTES:

ACTIONS	RESULTS
Issue CD/WR Restricted Route to train A over CP0031, north / Execute	Accepted by Host + DCP.

Test Not Necessary S/W to be Changed to allow only 1 Restricted Speed in Block MG aug 26/83

COMMENTS:

TEST CONFIRMED BY:

DATE:

BC RAIL

TEST PROCEDURE

SYSTEM: UC

TEST NO: 22

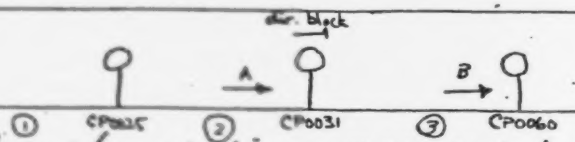
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb. 22, 83

TEST DESCRIPTION: Issue Cab Display /Written Restricted Route

SET UP: Train B occupying block ③ under CD Main, north over CP0
Train A occupying block ② under CD Main, north over CP0025
CP0031 blocked in the direction north.



NOTES: Reason for rejection: CP is blocked in the direction of authority.

ACTIONS	RESULTS
sue CD/WR Restricted Route to train A ver CP0031, north / Execute	1. Rejected by Host + DCP.

Test as Written would Not allow D/B over 0031 a/c train B in Block – + Ref Report # 882

If train B is Moved into Block # 4 Test is ?.

COMMENTS:

TEST CONFIRMED BY:

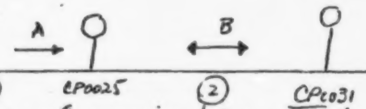
DATE:

BC RAIL

TEST PROCEDURE

SYSTEM: LIC
TEST NO: 23
TEST PHASE: CONFLICT
PREPARED BY: MG
DATE: Feb 22.83
TEST DESCRIPTION: Issue Cab Display/Written Restricted Route.

SET UP: Train B occupying block ② under WR Exclusive Work Authority between CP0025 and CP0031.



NOTES: Reason for rejection: Train B can travel in either directio

ACTIONS	RESULTS
ssue CD/WR Restricted Route to train A over CP0025, north /Execute	1. Rejected by Host + DCP

COMMENTS: Err msg Block in use

TEST CONFIRMED BY: OK

DATE: aug 25/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 24

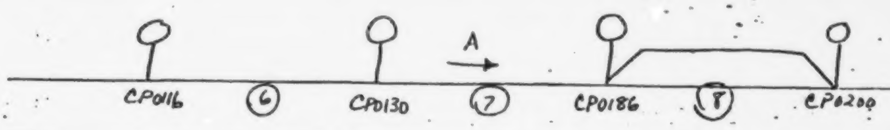
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb. 22, 83

TEST DESCRIPTION: Issue Switching Authority

SET UP: Train A occupying block ⑦ under CD Main, north over CP~~0031~~ 0130.



NOTES:

ACTIONS	RESULTS
Issue CD Switching to train A over ~~CP0060~~ CP0186 / Execute	1. Accepted by Host + DCP.

COMMENTS:

TEST CONFIRMED BY: OK

DATE: Aug 22/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 25

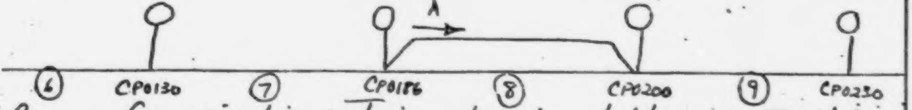
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb. 22, 83

TEST DESCRIPTION: Issue Cab Display Switching Authority

SET UP: Train A holds Switching Authority over CP0186 (train
could be on main or siding between CP0130 + CP0200).



NOTES: Reason for rejection: Train already holds one Switching
authority. Host Spec. p. 5-29 pre-req.

ACTIONS	RESULTS
Issue CD Switching to train A ver CP0200 / Execute.	1. Rejected by Host.

COMMENTS:

OTHER AUTH HELD HOST

TEST CONFIRMED BY:

DATE: Aug 22/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 26

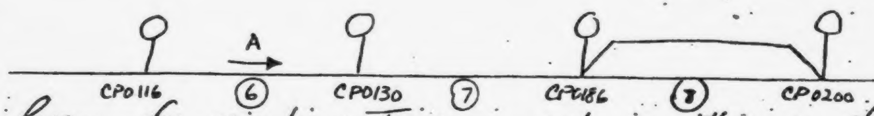
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb. 22, 83

TEST DESCRIPTION: Issue Cab Display Switching Authority

SET UP: Train A occupying block ⑥ under CD Main, north over CP0116.



NOTES: Reason for rejection: Train is not in either one of the two blocks adjacent to the Switching CP.

ACTIONS	RESULTS
Issue CD Switching to train A over CP0186	1. Rejected by Host

COMMENTS:

MSC- INVALID SEQU HOST

TEST CONFIRMED BY: ok

DATE: aug 22/83

BC RAIL

TEST PROCEDURE

SYSTEM: L/C

TEST NO: 27

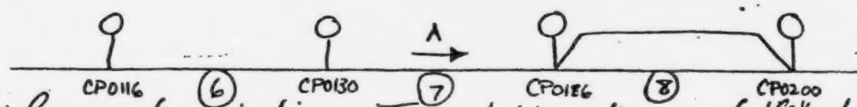
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb. 22, 83

TEST DESCRIPTION: Issue Cab Display Switching

SET UP: Train A occupying block ⑦ under CD Main, north over CP ~~0116~~.
Train A 0130 also holds CD Main north over CP0186.



NOTES: Reason for rejection: Train holds other unfulfilled authority.

ACTIONS	RESULTS
Issue CD Switching to train A over CP0186 / Execute	1. Rejected by Host.

COMMENTS:
MSG. OTHER AUTH HELD HOST

TEST CONFIRMED BY: ok

DATE: Aug 22/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 28

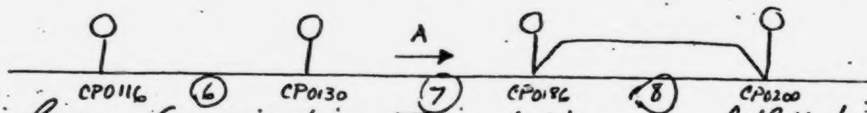
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb. 22,

TEST DESCRIPTION: Issue Cab Display Switching Authority

SET UP: Train A is occupying block ⑦ under CD Restricted Route, north over CP 0130.



NOTES: Reason for rejection: Train holds an unfulfilled restricted route authority.

ACTIONS	RESULTS
Issue CD Switching to train A over CP0186 / Execute	1. Rejected by Host.

COMMENTS:

MSG. OTHER AUTH HELD HOST

TEST CONFIRMED BY: UK

DATE: aug 22/83

BC RAIL

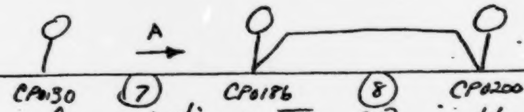
TEST PROCEDURE

SYSTEM: LIC TEST NO: 29

TEST PHASE: CONFLICT PREPARED BY: MG DATE: Feb 22, 83

TEST DESCRIPTION: Issue Cab Display Switching

SET UP: Train A occupying block ⑦ under CD Main, north over CP0130.
CP0186 blocked in the direction north.



NOTES: Reason for rejection: The CP is blocked.

ACTIONS	RESULTS
Issue CD Switching to train A over CP0186 / Execute	1. Rejected by Host + DCP.

COMMENTS:
CP BLOCKED HOST

TEST CONFIRMED BY: OK

DATE: Aug 22/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 30

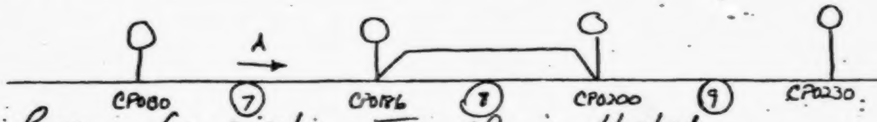
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb 22, 83

TEST DESCRIPTION: Issue Cab Display Switching

SET UP: Train A occupying block ⑦ under CD Main, north over CP0
CP0186 blocked in the direction south.



NOTES: Reason for rejection: The CP is blocked.

ACTIONS	RESULTS
Issue CD Switching to train A over CP0186 / Execute	1. Rejected by Host and DCP.

COMMENTS: CP BLOCKED HOST

TEST CONFIRMED BY: OK

DATE: Aug 22/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 31

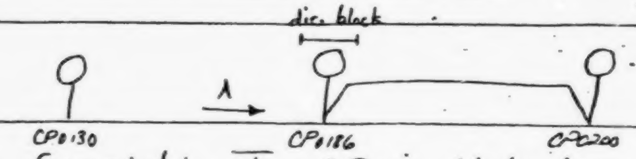
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb. 22, 83

TEST DESCRIPTION: Issue Cab Display Switching

SET UP: Train A occupying block ⑦ under CD Main, north over CP0130.
CP0186 blocked in both directions (i.e. south + north



NOTES: Reason for rejection: The CP is blocked.

ACTIONS	RESULTS
Issue CD Switching to train A nor CP0186 / Execute	1. Rejected by Host + DCP

COMMENTS:

CP BLOCKED HOST

TEST CONFIRMED BY: OK

DATE: aug 22/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 32

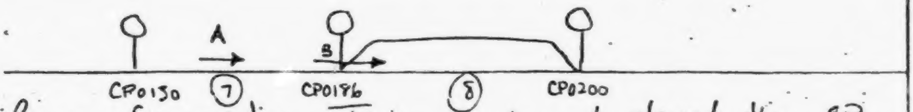
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb 22, 83

TEST DESCRIPTION: Issue Cab Display Switching

SET UP: Train B occupying blocks ⑦ and ⑧.
Train A occupying block ⑦



NOTES: Reason for rejection: Train B has not cleared the CP yet.

ACTIONS	RESULTS
Issue CD Switching to train A over CP0186 / Execute.	1. Rejected by Host + DCP

COMMENTS: ERR MSG OTHER AUTH HELD HOST

TEST CONFIRMED BY: OK

DATE: Aug 25/83

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 33

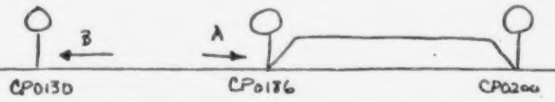
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb 22, 83

TEST DESCRIPTION: Issue Cab Display Switching

SET UP: Train B occupying block ⑦ and holding CD Main, south over CP0130.
Train A occupying block ⑦ and tavelling north.



NOTES:

ACTIONS	RESULTS
Issue CD Switching to train A over CP0186 / Execute	1 Accepted by Host + DCP

COMMENTS:

TEST CONFIRMED BY:

DATE: Aug 28/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 34

TEST PHASE: CONFLICT

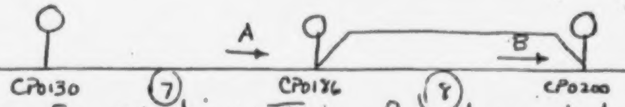
PREPARED BY: MG

DATE: Feb 22, 83

TEST DESCRIPTION: Issue Cab Display Switching

SET UP: Train B occupying block ⑧ under CD Main, north over CP0186.

Train A occupying block ⑦ under CD Main, north over CP0130.



NOTES: Reason for rejection: Train B does not have authorit out of block ⑧.

ACTIONS	RESULTS
Issue CD Switching to train A over CP0186 / Execute	1. Rejected by Host + DCP.

COMMENTS:

TEST CONFIRMED BY: OK PDR

DATE: aug 26, 1983

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 35

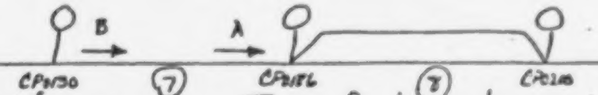
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb 22,83

TEST DESCRIPTION: Issue Cab Display Switching

SET UP: Train B occupying block ⑦ under Written Restricted, north over CP0130.
Train A occupying block ⑦ under CD Main, north over CP0130



NOTES: Reason for rejection: Train B is not moving away.

ACTIONS	RESULTS
Issue CD Switching to train A over CP0186 /Execute	1. Rejected by Host + DCP

COMMENTS: ERR MSG. BLOCK IN USE HOST

BC RAIL

TEST PROCEDURE

SYSTEM: L/C

TEST NO: 36

TEST PHASE: CONFLICT

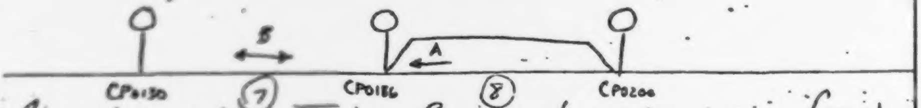
PREPARED BY: MG

DATE: Feb 23 83

TEST DESCRIPTION: Issue Cab Display Switching

SET UP: Train B occupying block ⑦ under WR Exclusive Work Auth. between CP0150 and CP0186

Train A occupying block ⑧ under CD Main, south over CP020



NOTES: Reason for rejection: Train B is not moving away from the switching CP.

ACTIONS	RESULTS
Issue ① Switching to train A over CP0186 /Execute	1. Rejected by Host + DCP

COMMENTS: ERR MSG BLOCK IN USE HOST

TEST CONFIRMED BY: OK

DATE: aug 26/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 37

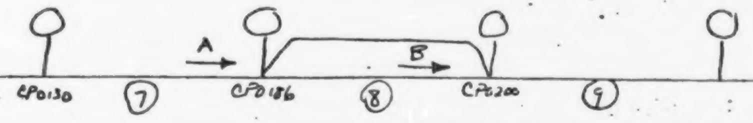
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb 23, 83

TEST DESCRIPTION: Issue Cab Display Switching

SET UP: Train B occupying block ⑧ under WR Restricted, north over CP0186 and holding WR Restricted north over CP0200. Train A occupying block ⑦ under CD Main, north over CP0130.



NOTES:

ACTIONS	RESULTS
Issue CD Switching to train A over CP0186 / Execute	1. Accepted by Host + DCP

COMMENTS:

TEST CONFIRMED BY:

DATE: Aug 29/83

BC RAIL

TEST PROCEDURE

SYSTEM: L/C

TEST NO: 38

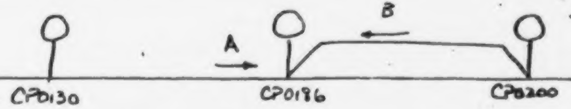
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb 23, 83

TEST DESCRIPTION: Issue Cab Display Switching

SET UP: Train B occupying block ⑧ under CD Siding, south over CP0200.
Train A occupying block ⑦ under CD Main, north over CP0186.



NOTES:

ACTIONS	RESULTS
Issue CD Switching to train A over CP0186 / Execute	1. Accepted by Host + DCP.

COMMENTS:

TEST CONFIRMED BY: OK

DATE: Aug 29/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 39

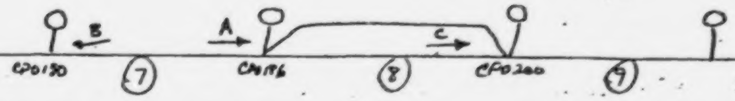
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb 23, 83

TEST DESCRIPTION: Issue Cab Display Switching

SET UP: Train B occupying block ⑦ under CD Restricted, south over CP0186, and holding CD Restricted south over CP0130. Train C occupying block ⑧ under WR Main, north over CP0186 and holding WR Main, north over CP0200.



NOTES:

ACTIONS	RESULTS
1. Issue CD Switching to train A over CP0186 / Execute	1. Accepted by Host + DCP.

COMMENTS:

TEST CONFIRMED BY: OK

DATE: Aug 29/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 40

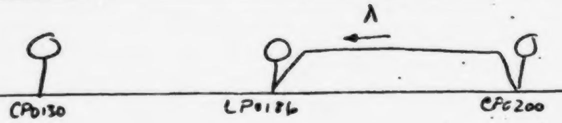
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb. 23, 83

TEST DESCRIPTION: Issue Cab Display Switching

SET UP: Train A occupying block ⑧ under WR siding, south over CP0200.



NOTES:

ACTIONS	RESULTS
Issue CD Switching to train A over CP0186 /Execute	1. Accepted by Host + DCP.

COMMENTS:

TEST CONFIRMED BY: OK

DATE: Aug 29/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 41

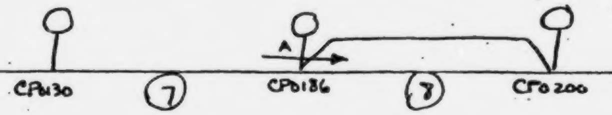
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb. 23 83

TEST DESCRIPTION: Issue Cab Display Switching

SET UP: Train A occupying blocks ⑦ and ⑧ (has not cleared the control point yet + is occupying main track)



NOTES:

ACTIONS	RESULTS
Issue Switching to train A near CP0186 / Execute	1. Accepted by Host + DCP.

COMMENTS:

TEST CONFIRMED BY: ok

DATE: Aug 22/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 42

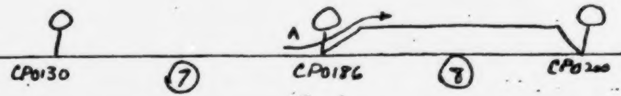
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb 23 83

TEST DESCRIPTION: Issue CD Switching

SET UP: Train A occupying blocks ⑦ and ⑧ on main and siding



NOTES:

ACTIONS	RESULTS
Issue Switching to train A over CP0186 / Execute	1. Accepted by Host + DCP.

COMMENTS:

TEST CONFIRMED BY: ok

DATE: aug 23/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 43

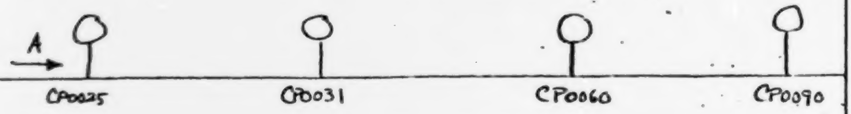
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb 23, 83

TEST DESCRIPTION: Issue Written Exclusive Work Authority (i.e. Train Occupancy)

SET UP: No restrictions, occupancies or authorities anywhere between CP0025 and CP0090.



NOTES:

ACTIONS	RESULTS
Issue Train Occupancy to train A between CP0025 + CP0090/Execute	1. Accepted by Host + DCP.

COMMENTS:

TEST CONFIRMED BY: OK

DATE: aug 25/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 44

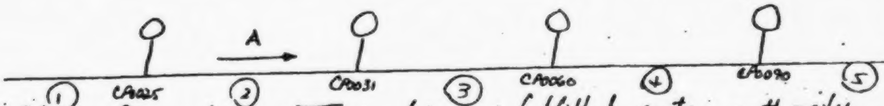
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb 23 83

TEST DESCRIPTION: Issue Written Exclusive Work Authority (i.e. Train Occupancy)

SET UP: Train A occupying block ② under (i) Main, north over CP0025, and holding Written Main, north over CP0031.



NOTES: Reason for rejection: Train has unfulfilled route authority inside the boundaries of the Train Occupancy.

ACTIONS	RESULTS
Issue Train Occupancy to train A between CP0025 and CP0090 / Execute	1. Rejected by Host.

COMMENTS: EAR MSC BLOCK IN USE

TEST CONFIRMED BY: OK

DATE: Aug 24/83

BC RAIL

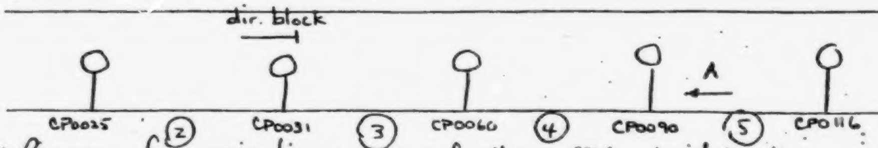
TEST PROCEDURE

SYSTEM: L/C
TEST NO: 45

TEST PHASE: CONFLICT
PREPARED BY: MG
DATE: Feb 23 83

TEST DESCRIPTION: Issue Written Exclusive Work Authority (i.e. Train Occupancy)

SET UP: Train A occupying block ⑤ under CD Main, south over CP0116.
CP0031 blocked in the direction north.



NOTES: Reason for rejection: One of the CP's inside the Train Occupancy is blocked.

ACTIONS	RESULTS
Issue Train Occupancy to train A between CP0025 and CP0090.	1. Rejected by Host + DCP.

COMMENTS: ERR MSG C/P BLOCKED HOST

TEST CONFIRMED BY: OK
DATE: aug 26/87

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 46

TEST PHASE: CONFLICT

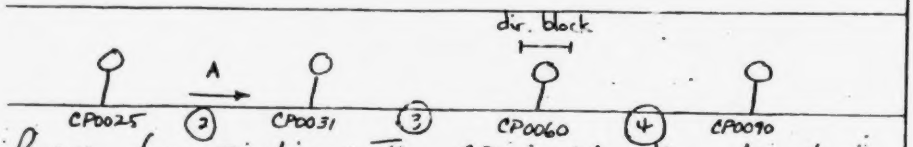
PREPARED BY: MG

DATE: Feb 23 83

TEST DESCRIPTION: Issue Written Exclusive Work Authority (i.e. Trai Occupancy)

SET UP: Train A occupying block ② under WR Main north over CP0025.

CP0060 blocked in both directions.



NOTES: Reason for rejection: The CP inside the boundaries of the WR occupancy is blocked.

ACTIONS	RESULTS
Issue Train Occupancy to train A between CP0031 and CP0090 / Execute	1. Rejected by Host + DCP.

COMMENTS: ERR MSG
CP BLOCKED HOST

TEST CONFIRMED BY: Ok

DATE: Aug 24/83

BC RAIL

TEST PROCEDURE

SEE FAULT 1019

SYSTEM: LIC

TEST NO: 47

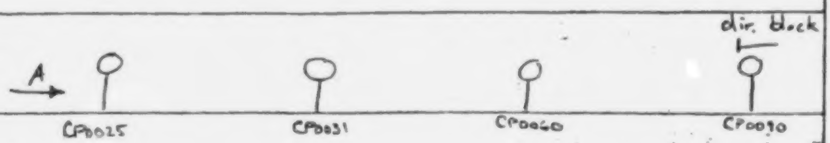
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb 23,83

TEST DESCRIPTION: Issue Written Exclusive Work Authority (i.e. Train Occupancy)

SET UP: CP0090 blocked in the direction south



NOTES:

ACTIONS	RESULTS
Issue Train Occupancy to train A between CP0025 and CP0090 /Execute	1. Accepted by Host + DCP.

COMMENTS: REJECTED BY DCP

TEST CONFIRMED BY: NO GOOD

DATE: aug 25/83

BC RAIL

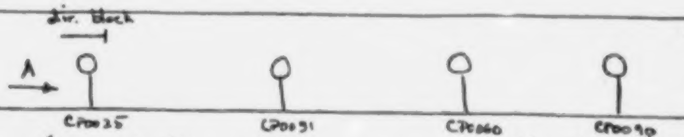
TEST PROCEDURE

SYSTEM: LIC TEST NO: 48

TEST PHASE: CONFLICT PREPARED BY: MG DATE: Feb. 23, 83

TEST DESCRIPTION: Issue Written Exclusive Work Authority (i.e. Train Occupancy)

SET UP: CP0025 blocked in the direction north



NOTES: Reason for rejection: Boundary CP blocked in the direction of entry.

ACTIONS	RESULTS
Issue Train Occupancy to train A between CP0025 and CP0090 / Execute	1. Rejected by the Host + DCP.

COMMENTS: ERR MSG CP BLOCKED HOST

TEST CONFIRMED BY: OK DATE: aug 25/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 49

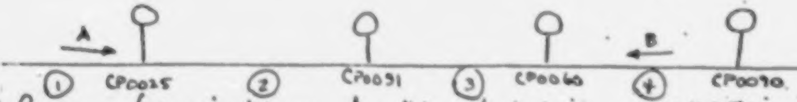
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb 23, 83

TEST DESCRIPTION: Issue Written Exclusive Work Authority (i.e. Train Occupancy)

SET UP: Train B occupying block ④ under CD Main, south over ~~[illegible]~~.
CP90



NOTES: Reason for rejection: Another train is inside the area.

ACTIONS	RESULTS
Issue Train Occupancy to train A between CP0025 and CP0090 / Execute	1. Rejected by Host + DCP.

COMMENTS: ERR MSG BLOCK IN USE HOST

DATE: Aug 25/87

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 50

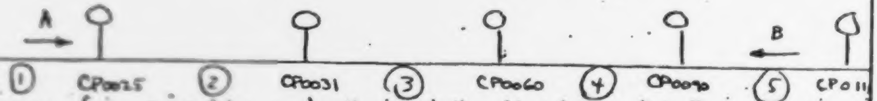
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb. 23, 83

TEST DESCRIPTION: Issue Written Exclusive Work Authority (i.e. Train Occupancy)

SET UP: Train B occupying block ⑤ under WR Main, south over CP0116 and holding WR Main, south over CP0090.



NOTES: Reason for rejection: Another train holds authority inside the boundaries of the WR Occupancy.

ACTIONS	RESULTS
Issue Train Occupancy to train A between CP0025 and CP0090 /Execute	1. Rejected by Host + DCP.

COMMENTS:

"Block in use" Host

TEST CONFIRMED BY:

DATE: Aug 29/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 51

TEST PHASE: CONFLICT

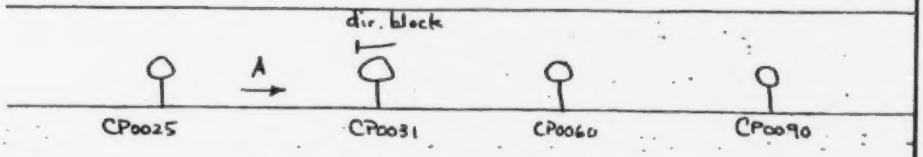
PREPARED BY: MG

DATE: Feb 23, 83

TEST DESCRIPTION: Issue Written Exclusive Work Authority (i.e. Train Occupancy)

SET UP: Train A occupying block ② under CD Main north over CP0025.

CP0031 blocked in the direction south.



NOTES:

ACTIONS	~~REJECT~~ RESULTS
Issue Train Occupancy to train A between CP 0031 + CP0090 / Execute	1. ~~Accepted~~ by Host + DCP. accepted recd not Coming South of 0031

COMMENTS:

TEST CONFIRMED BY: OK

DATE: Aug 29/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 52

TEST PHASE: CONFLICT

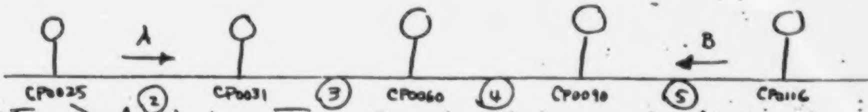
PREPARED BY: MG

DATE: Feb 23, 83

TEST DESCRIPTION: Issue ~~Written~~ Joint / Dual Work Authority

SET UP: Train A occupying block ② under CD Main north over CP0025.

Train B occupying block ⑤ under CD Main, south over CP0116.



NOTES: For Dual Work: Train B should be replaced by the forman ID. A MOW crew needs no set-up.

ACTIONS	RESULTS
Issue ~~Joint~~/Dual Work Auth	1. Accepted by Host + DCP
to trains A + B between CP0031	
and CP0090 / Execute	

COMMENTS:

TEST CONFIRMED BY: Ok

DATE: aug 25/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST PHASE: CONFLICT

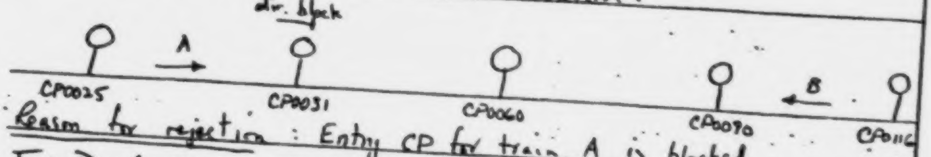
TEST NO: 53

PREPARED BY: MG

DATE: Feb 23, 83

TEST DESCRIPTION: Issue Written Joint/[✓ Dual] Work Authority

SET UP: Train A occupying block ② under we Main, north over CP0025. Train B occupying block ⑤ under WR Main. South over CP0116.
CP0031 blocked in the direction South.



NOTES: Reason for rejection: Entry CP for train A is blocked.
For Dual Work. Train B would be a forman ID.

ACTIONS	RESULTS
Issue Joint/Dual Work to trains A + B between CP0031 + CP0090 /Execute	~~Accepted~~ 1. Rejected by Host + DCP

COMMENTS:

TEST CONFIRMED BY: OK

DATE: Aug 25/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST PHASE: CONFLICT

TEST NO: 54

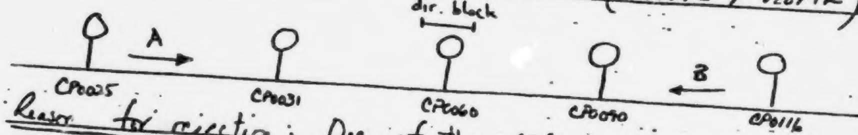
PREPARED BY: MG

DATE: Feb 23, 83

TEST DESCRIPTION: Issue Written Joint/Dual Work Authority.

SET UP: Train A occupying block ② under CD Main, north over CP0025. Train B occupying block ⑤ under CD Main, south over CP0116.

CP0060 blocked in both directions (south + north)



NOTES: Reason for rejection: One of the CP's inside the boundries of the WR occupancy is blocked.

ACTIONS	RESULTS
Issue ~~Joint~~/Dual Work to trains A + B between CP0031 + CP0090 /Execute	1. Rejected by Host + DCP.

COMMENTS: CP Blocked Host

TEST CONFIRMED BY: OK

DATE: Aug 11/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 55

TEST PHASE: CONFLICT

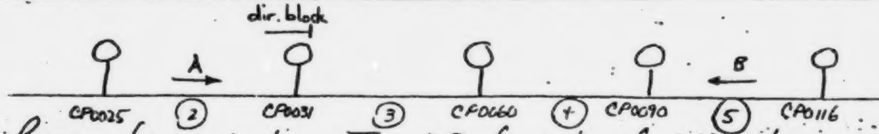
PREPARED BY: MG

DATE: Feb 23, 83

TEST DESCRIPTION: Issue Written Joint/Dual Work Authority

SET UP: Train A occupying block ② under WR Main, north over CP0025. Train B occupying block ⑤ under WR Main, south over CP0116.

CP0031 blocked in the direction north.



NOTES: Reason for rejection: The CP of entry for one train is blocked.

ACTIONS	RESULTS
Issue Joint/Dual Work to trains A + B between CP0031 + CP0090/Execute	1. Rejected by Host + DCP.

COMMENTS: ERR MSG CP BLOCKED HOST

TEST CONFIRMED BY: OK

DATE: aug 25/83

BC RAIL

TEST PROCEDURE

SYSTEM: LC

TEST NO: 56

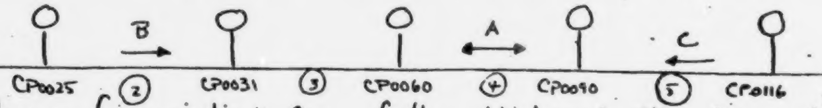
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb 23, 83

TEST DESCRIPTION: Issue Written Joint/Dual Work Authority

SET UP: Train A has WR Exclusive Work Authority (i.e. Train Occupa
between CP0060 + CP0090.
Train B occupying block ② under CD Main, north over CP00
Train C occupying block ⑤ under CD Main, south over CP0116



NOTES: Reason for rejection: One of the blocks inside the authori
is given to another train (i.e. train A)

ACTIONS	RESULTS
Issue ~~Joint~~/Dual Work to trains B+C between CP0031 + CP0090/Execute	1. Rejected by Host + DCP.

COMMENTS:
Block in use Host.

TEST CONFIRMED BY: OK

DATE: Aug 29/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 57

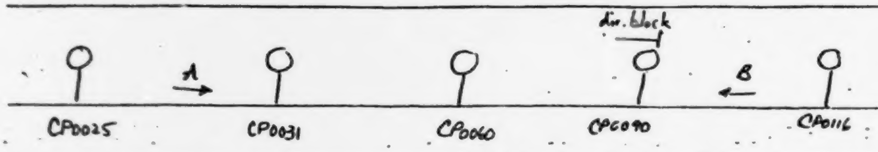
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb. 23, 83

TEST DESCRIPTION: Issue Written Joint / Dual Work Authority

SET UP: Train A occupying block ② under WR Main, north over CP00
Train B occupying block ⑤ under WR Main, south over CP0116
CP0090 is blocked in the direction north.



NOTES:

ACTIONS	RESULTS
Issue ~~Joint~~ / Dual Work to trains A + B between CP0031 + CP0090 / Execute	1. Accepted by Host + DCP.

COMMENTS:

TEST CONFIRMED BY: OK

DATE: Aug 29/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 58

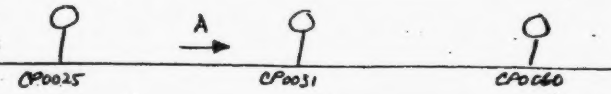
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb 24,83

TEST DESCRIPTION: Issue Directional Blocking

SET UP: Train A has WR Main, north over CP0031.



NOTES:

ACTIONS	RESULTS
Issue direction blocking over CP0031 in the direction north /Execute	1. Rejected by Host.

Mar 1,83

GDT.

Cancelling Instructions

Minoo G.

COMMENTS: other authy held Host.

TEST CONFIRMED BY: OK

DATE: May29/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 59

TEST PHASE: CONFLICT

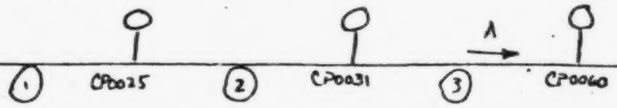
PREPARED BY: MG

DATE: Feb 24, 83

TEST DESCRIPTION: Issue Directional Blocking

SET UP: Train A is occupying block ③ under CD Restricted route, north over CP0031.

NOTES:



ACTIONS	RESULTS
Issue Directional Blocking over CP0031 in the direction north / Execute	1. Rejected by the Host.

COMMENTS: Older entry held Host

OK

TEST CONFIRMED BY:

DATE: Aug 29/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 60

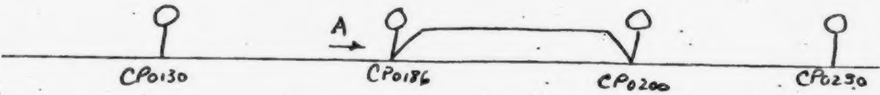
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb 24, 83

TEST DESCRIPTION: Issue Directional Blocking

SET UP: Train A holds Switching authority over CP0186.



NOTES:

ACTIONS	RESULTS
Issue Directional Blocking over CP0186 in the direction south / Execute	1. Rejected by Host.

COMMENTS: ERR MSG.
OTHER AUTH HELD HOST

TEST CONFIRMED BY: OK POR + [illegible]

DATE: Aug 29/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 61

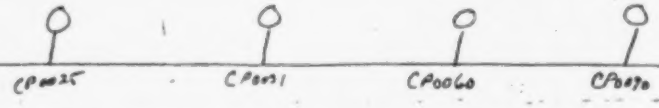
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb 24, 83

TEST DESCRIPTION: Issue Directional Blocking

SET UP: Train A holds Train Occupancy between CP0025 + CP009



NOTES:

ACTIONS	RESULTS
Issue Directional Blocking over CP0060 in the direction South / Execute	1. Rejected by the Host

COMMENTS: ERR MSG OTHER AUTH HELD HOST

TEST CONFIRMED BY: OK

DATE: Aug 27/83

BC RAIL

TEST PROCEDURE

SYSTEM: L/C

TEST NO: 62

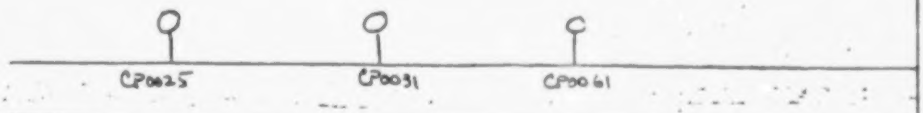
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb 24, 83

TEST DESCRIPTION: Issue Manual OS to an engine/eot

SET UP: Train A holds CO. Main, north over CP0031.



NOTES:

ACTIONS	RESULTS
Issue Manual OS to the engine/eot unit of train A over CP0031, in the direction north over main.	1. Accepted by Host.

COMMENTS:

TEST CONFIRMED BY: C K

DATE: aug 24/83

BC RAIL

SYSTEM: LIC

TEST NO: 63

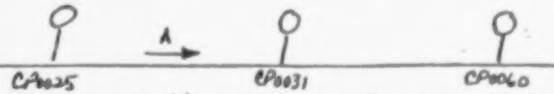
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb 24.83

TEST DESCRIPTION: Issue Manual OS to an engine /eat

SET UP: Train A occupying block ② under CD Main, north over CP0025.



NOTES: Reason for rejection: Train A does not hold authority over the Manual OS CP.

ACTIONS	RESULTS
Issue Manual OS for train A over CP0031 north on main / Execute	1. Rejected by Host

COMMENTS: GAR MSG AUTH NOT HELD HOST

TEST CONFIRMED BY: ~~auth not~~ OK

DATE: ~~aug~~ 24/80

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 64

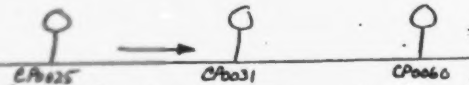
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb 24, 83

TEST DESCRIPTION: Issue Manual OS to an engine/eot an

SET UP: Train A holds CD, Main, north over CP0031.



NOTES: Reason for rejection: The direction of Manual OS does not match the direction of authority.

ACTIONS	RESULTS
Issue Manual OS to engine/eot unit of train A over CP0031, south on main /Execute	1. Rejected by Host

COMMENTS: AUTH NOT HELD HOST

TEST CONFIRMED BY: OK

DATE: Aug 24/83

BC RAIL

SYSTEM: L/C

TEST NO: 65

TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb 24, 83

TEST DESCRIPTION: Issue Switch OS

SET UP: Switch at CP0186

NOTES:

ACTIONS	RESULTS
Issue OS for switch 0186.	1. Accepted by Host

COMMENTS:

TEST CONFIRMED BY: OK

DATE: Aug 24/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 66

TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb 24, 83

TEST DESCRIPTION: Issue Switch OS

SET UP:

NOTES: Reason for rejection: No such switch in the system

ACTIONS	RESULTS
Issue OS for switch [illegible] 0230	1. Rejected by Host

COMMENTS: ERR MSH. INVALAD OS HOST

TEST CONFIRMED BY: OK

DATE: aug 24/83

BC RAIL

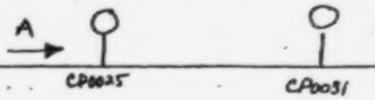
TEST PROCEDURE

SYSTEM: LK **TEST NO:** 67

TEST PHASE: CONFLICT **PREPARED BY:** MG **DATE:** Feb 24, 83

TEST DESCRIPTION: Cancel Cab Display Main Route

SET UP: Train A holds Cab Display Main, north over CP0025



NOTES:

ACTIONS	RESULTS
Cancel CD Main, north over CP0025 for train A / Execute	1. Accepted by Host + DCP.

COMMENTS:

TEST CONFIRMED BY: OK **DATE:** Aug 25/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 68

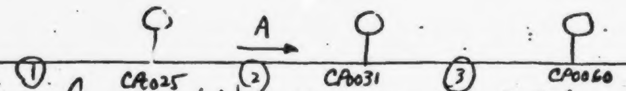
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb 24.83

TEST DESCRIPTION: Cancel Cab Display Main Route

SET UP: Train A occupying block ② under CD Main, north over CP0025.



NOTES: Reason for rejection: No authority left anymore to be cancelled (i.e. authority is already fulfilled)

ACTIONS	RESULTS
Cancel CD Main north over CP0025 to train A / Execute	1. Rejected by Host

COMMENTS: EFF MSC INVALID SEG HOST

TEST CONFIRMED BY: OK

DATE: aug 29/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 69

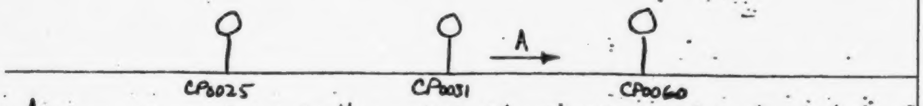
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb 24, 83

TEST DESCRIPTION: Cancel Written Main Route

SET UP: Train A holds WR Main Route over CP0031, north



NOTES: As soon as a Written authority is issued, the train is assumed to be occupying it

ACTIONS	RESULTS
Cancel WR Main, north over CP0031 for train A /Execute	1. Accepted by Host + DCP.

COMMENTS:

TEST CONFIRMED BY: OK

DATE: aug 25/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 70

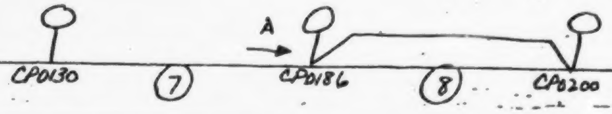
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb 24, 83

TEST DESCRIPTION: Cancel Cab Display Siding Route

SET UP: Train A holds CD. Siding, north over CP0186
Train A occupying block ⑦ under CD Main, north
over CP0130.



NOTES:

ACTIONS	RESULTS
Cancel CD Siding, north over CP0186 → train A / Execute	1. Accepted by Host + DCP.

COMMENTS:

TEST CONFIRMED BY: CH

DATE: aug 22/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 71

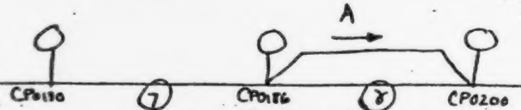
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb 24, 83

TEST DESCRIPTION: Cancel Cab Display Siding Route.

SET UP: Train A occupies block ⑧ under CD Siding, north over CP0186.



NOTES: Authority is already fulfilled.

ACTIONS	RESULTS
Cancel CD Siding, north over CP0186 for train A /Execute	1. Rejected

COMMENTS: ERR MSG INVALID SEQU HOST

TEST CONFIRMED BY: ok

DATE: aug 25/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 72

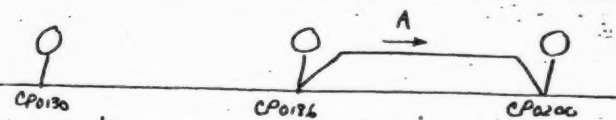
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb 24, 83

TEST DESCRIPTION: Cancel Written Siding Route

SET UP: Train A holds WR. Siding, north over CP0186.



NOTES: As soon as the authority is issued, the train is assumed to occupy the siding.

ACTIONS	RESULTS
Cancel WR Siding, north over CP0186 for train A / Execute	1. Accepted by Host + DCP.

COMMENTS:

TEST CONFIRMED BY: OK PDR

DATE: Aug 29/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 73

TEST PHASE: CONFLICT

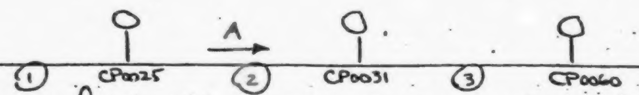
PREPARED BY: MG

DATE: Feb 24, 83

TEST DESCRIPTION: Cancel Cab Display Restricted Route.

SET UP: Train A occupying block ② under CD Main, north over CPo

Train A holds no outstanding authorities.



NOTES: Reason for rejection: Train A does not hold a Restricted Route Authority.

ACTIONS	RESULTS
Cancel CD Restricted, north over CP0031 for train A / Execute	1. Rejected by Host + DCP.

COMMENTS: FFF MSG INVALID SEQ HOS

TEST CONFIRMED BY: OK FFF

DATE: Aug 29/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 74

TEST PHASE: CONFLICT

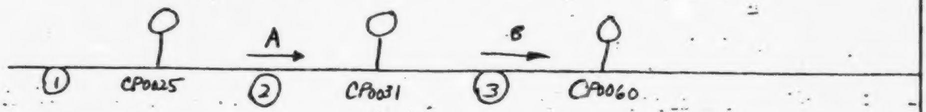
PREPARED BY: MG

DATE: Feb 24,83

TEST DESCRIPTION: Cancel Cab Display Restricted Route

SET UP: Train A occupying block ② under CD Main, north over CP0025. Train A holds CD Restricted, north over CP0031.

Train B occupying block ③ under CD Main, north over CP00



NOTES:

ACTIONS	RESULTS
Canced CD Restricted, north over CP0031 for train A /Execute	1. Accepted by Host + DCP.

COMMENTS:

TEST CONFIRMED BY: OK

DATE: aug 23/80

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 75

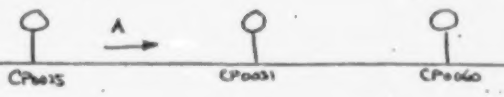
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb 24, 83

TEST DESCRIPTION: Cancel Cab Display/Written Restricted Route

SET UP: Train A occupies block ② under CD/WR Restricted, north over CP0025.



NOTES:

ACTIONS	RESULTS
ncel CD/WR Restricted, north over CP0025 for train A / Execute	1. Accepted by Host + DCP.

COMMENTS:

TEST CONFIRMED BY: JK PDR

DATE: Aug 29/85

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 76

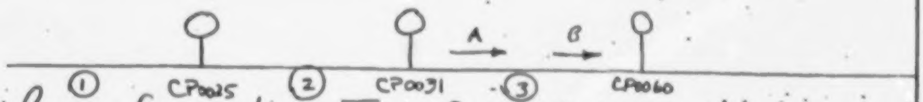
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb 24 83

TEST DESCRIPTION: Cancel Cab Display Restricted Route.

SET UP: Train B occupies block ③ under CD Main, north over CP0031
Train A occupies block ③ under CD Restricted, north
over CP0031.



NOTES: Reason for rejection: Train B is still in the block.

ACTIONS	RESULTS
ncel CD Restricted, north over CP0031 train A /Execute	1. Rejected by Host + DCP.

COMMENTS:

TRAIN IN BLOCK.

TEST CONFIRMED BY: ok

DATE: aug 22/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 77

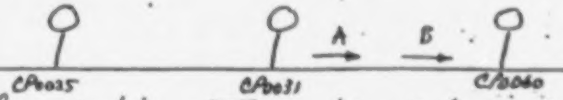
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb 24 83

TEST DESCRIPTION: Cancel Cab Display / Written Restricted Route

SET UP: Train B occupying block ③ under CD/WR Restricted, north over CP0031.
Train A occupying block ③ under CD/WR Restricted, north over CP0031.



NOTES: Reason for rejection: There is a train ahead of it in the same block.

ACTIONS	RESULTS
ncel CD/WR Restricted north over CP0031 for train A / Execute.	1. Rejected by Host + DCP.

COMMENTS:
TRAIN IN BLOCK HOST

TEST CONFIRMED BY: OK

DATE: aug 20/80

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 78

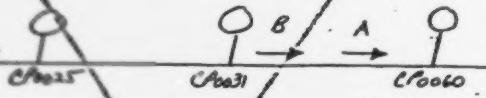
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb 24, 83

TEST DESCRIPTION: Cancel Cab Display / Written Restricted Route

SET UP: Train A occupies block ③ under CO/WR Restricted, north over CP0031.
Train B occupies block ③ under CO/WR Restricted, north over CP0031.



NOTES:

ACTIONS	RESULTS
ncel CO/WR Restricted, north over CP0031 for train A /Execute	1. ~~Accepted~~ Reject by Host + DCP.
This test can not be done. Require s/w to allow only 1 Restricted train in block - Aug 7/83 ERR TRAIN	IN BLOCK FAULT 1027

COMMENTS:

TEST CONFIRMED BY:

DATE:

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 79

TEST PHASE: CONFLICT

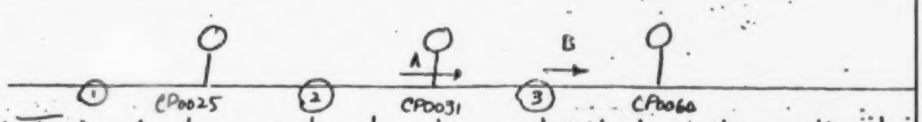
PREPARED BY: MG

DATE: Feb 24,83

TEST DESCRIPTION: Cancel Cab Display Restricted Route

SET UP: Train B occupying block ③ under CD Main, north over CP0031.

Train A occupying blocks ② and ③ and CD Restricted, north over CP0031.



NOTES: Train A has entered its restricted route authority.

ACTIONS	RESULTS
Cancel CD Restricted, north over CP0031 for train A / Execute	1. Rejected by Host + DCP.

COMMENTS: EFF MSG TRAIN IN BLOCK HOST

TEST CONFIRMED BY: OK MF

DATE: Aug 29/85.

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 80

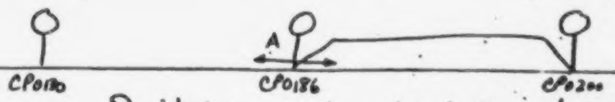
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb 24, 83

TEST DESCRIPTION: Cancel Switching Authority

SET UP: Train A holds. Switching authority over CP0186.



NOTES: As soon as Switching authority is issued, the train is assumed to occupy both blocks to the sides of the c

ACTIONS	RESULTS
Cancel Switching over CP0186 for train A / Execute	1. Accepted by Host + DCP.

COMMENTS:

TEST CONFIRMED BY: OK

DATE: aug 26/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 80A

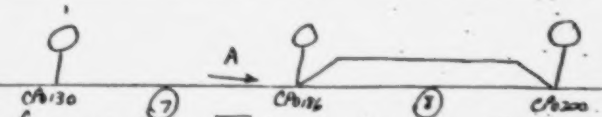
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb 24, 83

TEST DESCRIPTION: Cancel Switching Authority

SET UP: Train A holds CD Main, north over CP0186 and is occupying block ⑦ under CD Main, north over CP0130.



NOTES: Reason for rejection: Train A has no Switching authority.

ACTIONS	RESULTS
Cancel Switching over CP0186 for train A / Execute	1. Rejected by Host

COMMENTS:

AUTH NOT HELD HOST

TEST CONFIRMED BY: OK

DATE: Aug 22/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 81

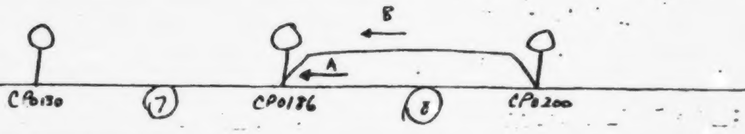
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb 25, 83

TEST DESCRIPTION: Cancel Switching Authority

SET UP: Train B occupying block ⑧ under CD Siding south over CP
Train A holds Switching over CP0186, but occupies block ⑧ on



NOTES:

ACTIONS	RESULTS
Cancel Switching over CP0186 for train A / Execute	1. Accepted by Host + DCP.

COMMENTS:

TEST CONFIRMED BY: ok DM PDR

DATE: aug 29/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 82

TEST PHASE: CONFLICT

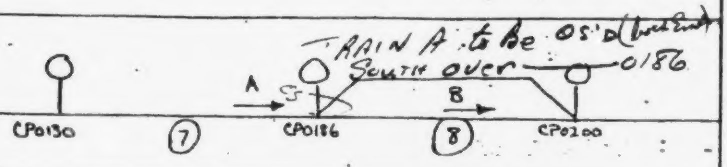
PREPARED BY: MG

DATE: Feb 25, 83

TEST DESCRIPTION: Cancel Switching Authority

SET UP: Train B occupying block ⑧ under CD Main, north over CP0186, and holding CD Main north over CP0200

Train A holds Switching over CP0186 and occupying block ⑦ only.


TRAIN A to Be OS'D (back End) South over 0186
A
B
CP0130
⑦
CP0186
⑧
CP0200

NOTES:

ACTIONS	RESULTS
Cancel Switching over CP0186 for train A / Execute	1. Accepted by Host + DCP.

COMMENTS:

TEST CONFIRMED BY:

DATE: Aug 24/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 83

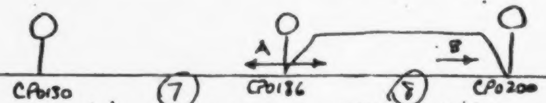
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb. 25, 83

TEST DESCRIPTION: Cancel Switching Authority

SET UP: Train B occupying block ⑧ under WR Main, north over CP018
and holds WR Main, north over CP0200.
Train A holds Switching over CP0186 and occupies blocks ⑦ + ⑧



NOTES: Reason for rejection: Train A + Train B occupy block ⑧ together.

ACTIONS	RESULTS
Cancel Switching over CP0186 for train A / Execute	1. Rejected by Host + DCP.

COMMENTS:

TEST CONFIRMED BY: OK

DATE: Aug 25/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 84

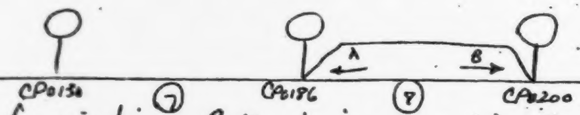
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb. 25, 83

TEST DESCRIPTION: Cancel Switching Authority

SET UP: Train B occupying block ⑧ under CD Main, north over CP018
and holding CD Main, north over CP0200.
Train A holds Switching over CP0186 and occupies block ⑧
only.



NOTES: Reason for rejection: Both trains are in the same block

ACTIONS	RESULTS
Cancel Switching over CP0186 for Train A / Execute	1. Rejected by Host + DCP.

COMMENTS:

TEST CONFIRMED BY:

DATE: Aug 25/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 85

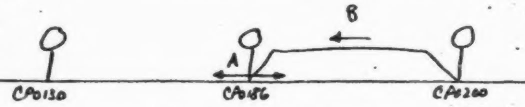
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb 25 83

TEST DESCRIPTION: Cancel Switching Authority

SET UP: Train B occupying block ⑧ under ① Siding, south over CP0200.
Train A holds Switching over CP0186 and is occupying blocks ⑦ and ⑧.



NOTES:

ACTIONS	RESULTS
Cancel Switching over CP0186 for Train A / Execute	1. Accepted by Host + DCP.

COMMENTS: OK

TEST CONFIRMED BY:

DATE: Aug 25/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 86

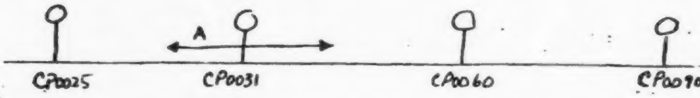
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb. 25, 83

TEST DESCRIPTION: Cancel ~~Written Exclusive Work Authority~~ (i.e. Train Occupancy)

SET UP: Train A holds Train Occupancy between CP0025 + CP0060



NOTES:

ACTIONS	RESULTS
Cancel Train Occupancy between CP0025 - CP0060 for train A / Execute	1. Accepted by Host + DCP

COMMENTS:

TEST CONFIRMED BY: OK

DATE: Aug 25/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 87

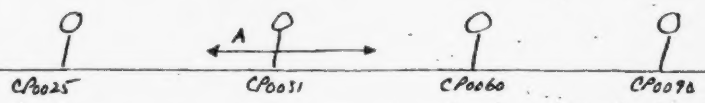
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb 25, 83

TEST DESCRIPTION: Cancel Written Exclusive Work Authority (i.e. Train Occupancy)

SET UP: Train A hads Train Occupancy between CP0025 + CP0060.



NOTES:

ACTIONS	RESULTS
Cancel Train Occupancy between CP0025 CP0031 for train A /Execute.	1. Accepted by Host + DCP.

COMMENTS:

TEST CONFIRMED BY: OK

DATE: aug 24/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 88

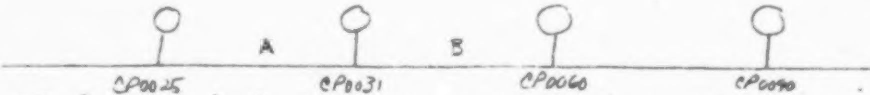
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb. 25, 83

TEST DESCRIPTION: Cancel Written Joint/Dual Work Authority

SET UP: Train A and Train B hold Joint Work between CP0025 and CP0060.



NOTES: For Dual Work Authority either train could be replaced by a MOW crew

ACTIONS	RESULTS
Cancel WR Joint/Dual Work for both trains (or 1 train + 1 MOW) between CP0025 and CP0060 / Execute	1. Accepted by Host + DCP.

COMMENTS:

TEST CONFIRMED BY: ok

DATE: aug 24/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 89

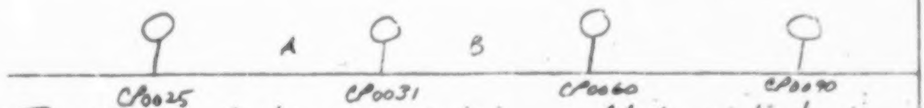
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb 25, 83

TEST DESCRIPTION: Cancel Written ~~Joint~~/Dual Work Authority

SET UP: Trains A + B hold WR Joint/Dual Work Authority between CP0025 + CP0060.



NOTES: For Joint work, either train could be replaced by a MOW crew.

ACTIONS	RESULTS
Cancel WR Joint/Dual Work for both trains (or 1 train + 1 MOW) between CP0025 + CP0031/Execute	1. ~~Accepted~~ by Host + DCP REJECTED

Err msg. Auth not held Host

COMMENTS:

TEST CONFIRMED BY: OK

DATE: Aug 24/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 90

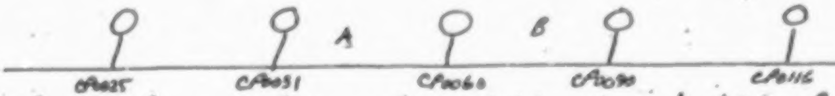
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb 25, 83

TEST DESCRIPTION: Cancel Written ~~Joint~~ OVAL Work Authority

SET UP: Trains A + B hold WR Joint Work between CP0031 + CP0090.



NOTES: Reason for rejection: Cancellation is not done for both trains at the same time (Host spec p.5-35)

ACTIONS	RESULTS
Cancel WR Joint Work between CP0031 + CP0090 for train A/ Execute	1. Rejected by Host

EAR ASC Progr. FAIL HOST

COMMENTS:

TEST CONFIRMED BY: OK

DATE: Aug 15/80

BC RAIL

TEST PROCEDURE

SYSTEM: UC

TEST NO: 91

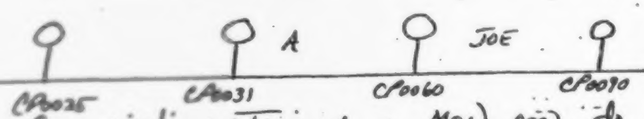
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb 25, 83

TEST DESCRIPTION: Cancel Written ~~Dual~~ JOINT Work Authority

SET UP: Train A and Maintenance of Way crew hold Dual Work authority between CP0031 + CP0090.



NOTES: Reason for rejection: Train A + MOW crew do not hold such authority

ACTIONS	RESULTS
ncel WR Dual Work authority tween CP0025 + CP0031 for rain A and MOW crew / Execute	1. Rejected by Host.

COMMENTS: ERR MSG. AUTH NOT HELD HOST

TEST CONFIRMED BY: ok

DATE: Aug 24/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 92

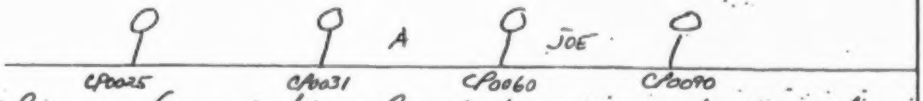
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb 25, 83

TEST DESCRIPTION: Cancel Written ~~Dual~~ JOINT Work Authority

SET UP: Train A and MOW crew hold Dual Work authority betwee CP0031 + CP0090.



NOTES: Reason for rejection: Cancellation is not done for both the train + MOW crew at the same time.

ACTIONS	RESULTS
Cancel WR Joint work authority between CP0031 + CP0090 for MOW crew / Execute	1. Rejected by Host

COMMENTS: ERR MSG. PREREQV FAIL HOST

TEST CONFIRMED BY: OK

DATE: Aug 24/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 93

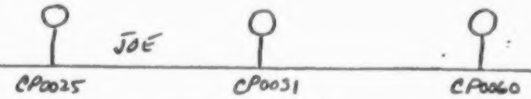
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb 25, 83

TEST DESCRIPTION: Cancel Written Maintenance of Way Authority

SET UP: Maintenance of Way holds work authority between CP0025 + CP0060.



NOTES:

ACTIONS	RESECT RESULTS
Cancel WR Maintenance of Way authority between CP0025 + CP0031 / Execute	1. ~~Accepted~~ by Host + DCP authority [illegible] Host

COMMENTS:

TEST CONFIRMED BY: OK

DATE: Aug 22/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 94

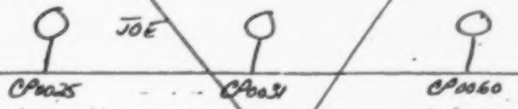
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb 25, 85

TEST DESCRIPTION: Cancel Written Maintenance of Way Authority

SET UP: Maintenance of Way. Crew holds work authority between CP0025 and CP0060.



NOTES:

ACTIONS	RESULTS
Cancel WR Maintenance of Way authority between CP0025 + CP0031.	1. Accepted by Host + DCP.

SAME AS 93

COMMENTS:

TEST CONFIRMED BY:

DATE:

BC RAIL

TEST PROCEDURE

SYSTEM: LC

TEST NO: 95

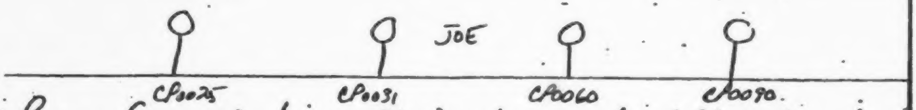
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb 25, 83

TEST DESCRIPTION: Cancel Written Maintenance of Way Authority

SET UP: Maintenance of Way Crew holds work authority between CP0031 and CP0060.



NOTES: Reason for rejection: MOW does not hold the authority which is being cancelled.

ACTIONS	RESULTS
Cancel Maintenance of Way authority between CP0025 + CP0031 / Execute /	1. Rejected by Host + DCP.

COMMENTS:

MSC AUTH NOT HELD

TEST CONFIRMED BY: OK

DATE: aug 22/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 96

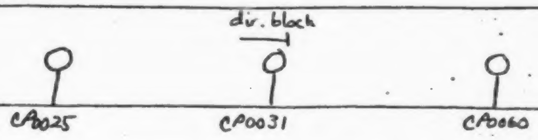
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb 25, 83

TEST DESCRIPTION: Cancel Directional Blocking

SET UP: CP0031 blocked in the direction north



NOTES:

ACTIONS	RESULTS
Cancel Directional Blocking on CP0031 in direction north / Execute	1. Accepted by Host.

COMMENTS:

TEST CONFIRMED BY: OK

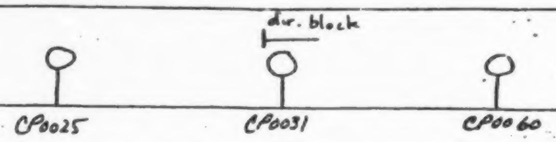
DATE: aug 22/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC
TEST NO: 97
TEST PHASE: CONFLICT
PREPARED BY: MG
DATE: Feb 25, 83
TEST DESCRIPTION: Cancel Directional Blocking

SET UP: CP0031 blocked in the direction south.



NOTES:

ACTIONS	RESULTS
Cancel Directional Blocking on P0031 in direction south / Execute	1. Accepted by Host.

COMMENTS:

TEST CONFIRMED BY: Ok
DATE: aug 22/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 98

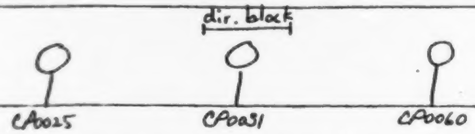
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Feb 25, 83

TEST DESCRIPTION: Cancel Directional Blocking

SET UP: CP0031 blocked in both directions (north + south)



NOTES:

ACTIONS	RESULTS
Cancel Directional Blocking on CP0031 in both directions/Execute.	1. Accepted by Host.

COMMENTS:

TEST CONFIRMED BY: OK

DATE: aug 22/83

BC RAIL

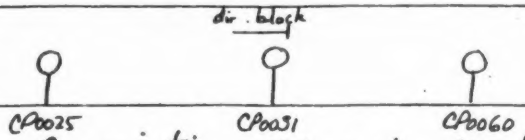
TEST PROCEDURE

SYSTEM: LIC TEST NO: 99

TEST PHASE: CONFLICT PREPARED BY: MG DATE: Feb 25, 83

TEST DESCRIPTION: Cancel Directional Blocking

SET UP: CP0031 blocked in the direction north



NOTES: Reason for rejection: No such directional blocking exists on CP0025.

ACTIONS	RESULTS
Cancel Directional Blocking for CP0025 in the direction north / Execute	1. Rejected by Host + DCP

COMMENTS:

CP NOT BLOCKED HOST

TEST CONFIRMED BY: OK DATE: aug 22/80

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 100

TEST PHASE: CONFLICT

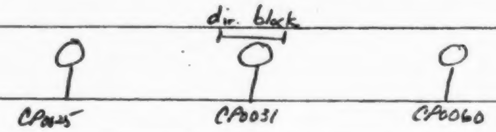
PREPARED BY: MG

DATE: Feb 25 83

TEST DESCRIPTION: Cancel Directional Blocking

SET UP: CP0031 blocked in both directions

NOTES:



ACTIONS	RESULTS
Cancel Directional Blocking on CP0031 in the direction south / Execute	1. Accepted by the Host CP0031 remains blocked in the direction north

COMMENTS:

TEST CONFIRMED BY: ok

DATE: aug 23/83

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 101

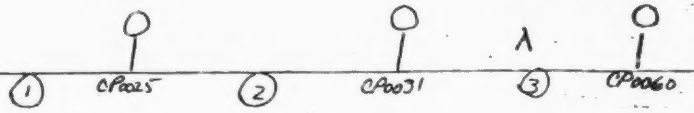
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Mar. 1, 83

TEST DESCRIPTION: Cancel Computer Protect

SET UP: Train A under Computer Protect in block 3



NOTES:

ACTIONS	RESULTS
Cancel Computer Protect for train A between CP0031 + CP0060/ Execute	1. Accepted by Host.

COMMENTS:

TEST CONFIRMED BY: OK

DATE: aug 24/80

BC RAIL

TEST PROCEDURE

SYSTEM: LIC

TEST NO: 102

TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Mar 1, 83

TEST DESCRIPTION: Cancel Occupancy

SET UP: Occupancy between CP0031 + CP0060

NOTES:

ACTIONS	RESULTS
Cancel Occupancy between CP0031 + CP0060 / Execute	1. Accepted by Host

COMMENTS:

TEST CONFIRMED BY: ok EM

DATE: aug 24/83

BC RAIL

TEST PROCEDURE

SYSTEM: 4C

TEST NO: 103

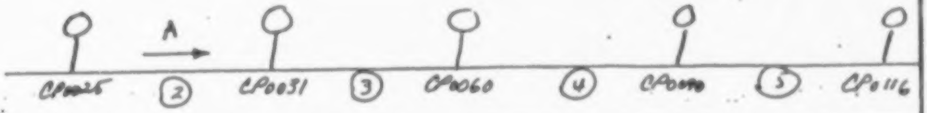
TEST PHASE: CONFLICT

PREPARED BY: MG

DATE: Mar. 1, 83

TEST DESCRIPTION: Manual Overrides

SET UP: Train A occupies block 2 under CD Main, north over CP0025 + holds CD Main north over CP0031, CP0060 + CP0090.



NOTES:

ACTIONS	RESULTS
Manual Override for train A / Execute	1. Accepted by the Host Computer Protect over blocks 2 - 5 inclusive.

COMMENTS:

TEST CONFIRMED BY: OK

DATE: aug 24/83

BC RAIL